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A Preliminary Report on the
Livermore Valley Earthquake
Sequence January 24 - February 26, 1980

by

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Abstract

On January 24, 1980, an earthquake of magnitude 5.9 occurred on the Marsh Creek-Greenville fault system 17 km north of Livermore, California. A single foreshock preceded the earthquake and approximately 600 aftershocks followed during the next 33 days. The largest aftershock, occurring $2\frac{1}{2}$ days later, had a magnitude of 5.3 and located 14 km southeast of the main shock. Fault-plane solutions from P-wave first motions suggest that the focal mechanisms for the main and most aftershocks consist predominantly of dextral strike-slip movement on fault planes striking north to northwest. The distribution of P and T axes are indicative of NE-SW compression of the Livermore Valley. These data are consistent with geologic field mapping showing dextral movement on the Marsh Creek-Greenville fault system. Seismic moments computed for the main shock and largest aftershock are 6×10^{24} and 1.5×10^{24} dyne-cm.

Two clusters of aftershocks lie significantly away from the main aftershock trend. These events are probably due to sympathetic movement along subsidiary faults.

Introduction

On January 24, 1980 at 1900 UTC (1100 am PST) a magnitude 5.9 earthquake occurred on the Greenville fault in the sparsely populated area approximately 17 km north of Livermore, California (Figs. 1 and 2). The earthquake was preceded by a magnitude 2.5 foreshock at 1858 UTC and was followed immediately by many aftershocks. The earthquake was widely felt throughout central California and western Nevada. Damage was reported from various locations in the Livermore Valley and surrounding area and in particular at the nuclear research facility at Lawrence Livermore Laboratory (LLL), 5 km east of Livermore, and at the Sunrise Mobile Home Park 3 km northeast of Livermore. Damage to the LLL facility was estimated to approach \$10 million (Woods, 1980). Most damage consisted of broken glass and pipes, overturned shelves, and dislodged trailers. However, the most serious damage occurred to the Shiva Laser, which is used for research at LLL. Mounting bolts which anchor the target apparatus were sheared off due to the shaking, resulting in instrument misalignment that required extensive repairs. At the Sunrise Mobile Home Park 90 of 133 trailers fell from their support and all but 3 of them suffered damage (Strata, 1980).

The Livermore Valley was again substantially shaken at 0233 UTC on January 27 (0633 pm January 26 PST) by another moderate sized earthquake, of magnitude 5.3 (Figs. 1 and 2). This event was also located on the Greenville fault, approximately 7 km NNE of Livermore. Minor damage and numerous felt reports were associated with this tremor.

This earthquake sequence is significant in that these are the largest earthquakes to have occurred in this area since the magnitude 5 earthquake of June 11, 1903. Historically, this area has been characterized by a diffuse pattern of seismicity (Ellsworth and Marks, 1980; Real and others, 1978; Bolt and Miller, 1975). It is our intent in this paper to present data pertinent to this earthquake sequence in a timely manner. This report is therefore limited in scope and preliminary in nature.

Tectonic Setting

The Livermore Valley is a broad east-west trending valley in northeastern Alameda County, California approximately 50 km east of San Francisco. The valley is bounded on the west by the Calaveras-Sunol fault and on the east by the Greenville fault. Recent mapping by Herd (1977) has revealed the Las Positas fault along the southeast margin of the valley and provided a reinterpretation of the location of the Verona fault, originally mapped by Hall (1958), which uplifts the low hills at the southwestern corner of the Valley (Figure 2).

The Greenville fault, named by Huey (1948), is poorly exposed, and traceable only as a series of linear, northwest-trending valleys, scarps, and notches, mostly within the Cierbo Sandstone (Herd, 1977). Offsets of alluvium indicate right-lateral strike-slip movement has occurred at least as late as the Pleistocene (Herd, 1977). Field mapping after January 24 1980 revealed recent surface ruptures associated with various strands of the Greenville fault and these were observed to have resulted from the January 24th event (Bonilla and other, 1980). Late Pleistocene movement on the fault appears to be mainly strike-slip with some vertical dip-slip component (Huey, 1948; Herd, 1977). Displacements associated with these recent earthquakes support this interpretation with maximum observed offsets of 25 mm of right lateral slip and some vertical displacement with the northeast side relatively up-thrown by 50 mm (Bonilla and others, 1980).

The Las Positas fault was named by Herd (1977) for its exposure in the west bank of Arroyo Seco in the Las Positas Valley south of the Lawrence Livermore Laboratory. It is characterized by a series of

aligned scarps and vegetation patterns within the Livermore Gravels and alluvial terraces south of Livermore, and it also forms the contact between the Livermore Gravels and the Cierbo Sandstone SSE of Livermore. Prior to the 1980 sequence of earthquakes the most recent movement on the fault is believed to have occurred possibly as late as Holocene time, as evidenced by possible offsets in recent flood-plain alluvium (Herd, 1977). Field mapping by Bonilla and others (1980) revealed small tectonic surface displacements occurred along the Las Positas fault, SSE of Livermore, probably at the time of the main shock on January 24, 1980. Field evidence suggests left-lateral displacement of this fault which is consistent with the inferred left-lateral oblique slip previously described by Herd (1977).

Data Collection and Analysis

The Livermore Valley earthquakes occurred on the eastern edge of the U.S.G.S. Central California Microearthquake Network (Figure 1). There are 27 permanent high-gain vertical stations located within approximately 50 km of the mainshock-aftershock sequence. Data from these stations are telemetered to Menlo Park via telephone lines and/or radio links and are recorded both on 16 mm photographic film and analog magnetic tape. Each roll of film contains about 24 hours recording time. A description of the permanent seismic network is given by McHugh and Lester (1978).

Because of insufficient station coverage to the east, it was necessary to augment the permanent stations. Within a few hours of the occurrence of the mainshock, 4 temporary 3-component stations were deployed and the information was recorded locally on magnetic tape. A complete listing of stations used in the present study is given in Table 1.

The telemetered seismic data yield first P-arrivals times, directions of first P-motions, maximum amplitudes, and signal durations. These data are then processed by computer to give origin time, hypocenter location, magnitude, and pattern of first motions of the earthquakes using the HYP071 computer program (Lee and Lahr, 1972).

In this study, events with a signal duration of 8 seconds or more were timed. Signal duration is defined as the duration time in seconds from the onset of the first P-arrival to the point where the trace amplitude (peak-to-peak) falls below 1 cm as it appears on the Geotech film viewer (20x magnification). This should correspond to a cutoff at about magnitude 1 for events within the OES network. Some smaller events with 6 clear first arrivals were also timed. A total of 573 events during the first 33 days following the mainshock were located. These hypocenter solutions are tabulated in the Appendix and illustrated in Figure 3.

Crustal Model and Earthquake Locations

Locations of earthquakes were based on first P-arrivals. The HYP071 computer program uses Geiger's method (Geiger, 1912) to determine hypocenters by minimizing the residuals between observed and calculated arrivals by a least-squares method. Traveltimes from a trial hypocenter to the stations and their partial derivatives are computed on the assumptions of a horizontal multilayer velocity model by a technique described by Eaton (1969).

The crustal velocity model used was derived from the analysis of explosion and earthquake traveltime data by Ellsworth and Marks (1980). It is specified by:

<u>Layer</u>	<u>Depth (km)</u>	<u>P-velocity (km/sec)</u>
1	0 - 1	3.4
2	1 - 3	4.7
3	3 - 5	5.2
4	5 - 7	5.6
5	7 - 9	5.7
6	9 - 11	5.8
7	11 - 13	6.0
8	13 - 25	6.8
9	below 25	8.0

Lateral velocity variations resulting from inhomogeneities within the earth's crust made it necessary to use an arrival time correction for each station when computing hypocenter solutions. These corrections were calculated using explosion and earthquake travel time data and were normalized so that the correction for station CMO was zero (0.00) (Ellsworth and Marks, 1980). A list of station corrections is given in Table 1.

Some of the earthquakes listed in this report are multiple events, that is, earthquakes from a given source region which occur in such rapid succession that the seismographs are still recording one earthquake when the first arrivals from a following earthquake begin. Depending on the size of the individual events and their separation in time, it may be possible to accurately time and locate the later event(s). Immediately after the main shock, on January 24, some earthquakes are barely discernable in the codas of earlier events. Locations for these events, where attempted, are of substantially lower quality than those obtained for distinct events.

Mainshock

The Livermore Valley earthquake sequence of late January and February 1980 began with a $M_c = 2.5$ foreshock 2 minutes before the main shock.

Parameters of the main shock are:

Origin time: 24 January 1980, 19^h 00^m 9.7^s UTC

Epicenter: 37° 49.58' N, 121° 47.16' W

Focal depth: 7.6 km $\pm$ 1 km

Magnitude: 5.9 (see magnitude discussion and Table 2).

These hypocentral coordinates place the main shock focus approximately 2 km east of the Marsh Creek - Greenville (MCG) fault system at a depth of 7½ km. This focal depth is not unusual compared with other central California earthquakes (Eaton et al., 1970; Wesson et al., 1973).

The P-wave focal mechanism of the main shock, constructed from over 240 first-motion readings at USGS seismograph stations throughout central and northern California, is consistent with predominately right-lateral strike-slip movement on a northerly-trending fault plane (Fig. 5a). The choice of a fault plane is consistent with the trend of the MCG fault (Brabb et al., 1971) in this area. This solution is also consistent with the overall faulting pattern in the Livermore Valley region of dextral strike slip movement on north to north-west trending faults (Ellsworth and Marks, 1980).

Magnitudes

The method used for estimating the Richter magnitudes listed in the Appendix has been described by Lee et al., (1972a). In brief, the magnitude of an earthquake is based on the average of magnitudes estimated at various stations. Station magnitude (M_c) is derived from its recorded signal duration (t) in seconds according to:

$$M_c = -0.87 + 2.00 \log (t) + 0.0035 \Delta$$

where Δ is the epicentral distance in kilometers.

Local magnitudes (M_E) for three events (Table 2) were calculated from trace amplitude measurements for comparison with the other magnitude determinations (J. P. Eaton, pers. comm.). The maximum peak-to-peak amplitude and associated period was converted to the amplitude that would have been recorded by a Wood-Anderson seismograph at the same station location. The magnitude was then determined using Richter's formula. An empirically determined correction of 0.25 is added to each magnitude computed from the vertical component of ground motion. In addition to this method, signal durations for the same three events were measured from 18 widely separated stations within the USGS central California

Network (OES) and M_c was calculated (Table 3). The M estimates are in remarkably good agreement with the M_E values determined by J. P. Eaton.

The M estimates for these three events reported by the Seismographic Station of the University of California, Berkeley (BRK) were estimated from the maximum trace amplitudes recorded by the 100x torsion seismograph located at BRK (Table 2).

A comparison was made of coda magnitudes for 62 aftershocks with Wood-Anderson magnitudes from BRK's monthly bulletin (McKenzie, 1980). We found that coda magnitudes (M_c) average 0.3 (s.d. = ± 0.2) magnitude units lower than those reported by BRK for $2.5 \leq M_L \leq 4.9$. A similar difference has been noted by Bakun (unpublished data, pers. common). This comparison does not include the 3 earthquakes listed in Table 2. A discussion of magnitude calculations, the meaning of magnitude, and the apparent difference between coda magnitudes and BRK's is beyond the scope of this report. For the sake of consistency we adopt the M values for these earthquakes unless noted otherwise.

Three other magnitude estimates for these earthquakes also appear in Table 2. The m_b and M_s magnitudes are the body-wave and surface-wave magnitudes, respectively, reported by the National Earthquake Information Service (NEIS) of the U.S.G.S. in Golden, Colorado. M_w is the moment-magnitude defined by Kanamori (1977) as

$$M_w = \frac{2}{3} \log M_0 - 10.73,$$

where M_0 is the seismic moment. Taken together, the suite of magnitude estimates indicate that the magnitude of the main shock of January 24 exceeds the magnitude of the large event of January 27 by about $\frac{1}{2}$ a magnitude unit. Whether or not the second large event should be called an aftershock is a question of semantics.

Source Parameters

The seismic moment (M_0), effective stress and rupture radius of the main shock and the largest aftershock (January 27), as computed by Boatwright (pers. comm., 1980) from the the displacement pulse, are listed in Table 4. These moments compare well with those determined by Bolt et al. (1980) from integration of the far-field P pulse (Table 4). This earthquake is composed of multiple sub-events separated in time by a few tenths of a second. The effective stress for the first 2 sub-events is between 100 and 200 bars with a rupture radius of approximately 2 km (Table 4).

The January 27 shock, like the mainshock, is also a multiple event. However, it is composed of only 2 principal sub-events separated by .2 sec. The effective stress is from 150 to 200 bars with a rupture radius of approximately 2 km (Table 4).

Aftershock Distribution

The aftershock distribution of this earthquake is primarily concentrated along a 20-km-long segment of the MCG fault system, with a few isolated clusters occurring well to the west (Figure 3). It contains a dense cluster of foci at the north end which surrounds the main shock hypocenter. A diffuse zone of epicenters extends unilaterally to the southeast for approximately 25 km. The aftershock pattern was essentially fully developed within the first 24 hours following the main shock. Even though the epicenters are displaced approximately 1 km east of the mapped surface trace of the MCG fault system, the distribution of epicenters suggests that the Livermore Valley earthquake sequence involved movement within a 30-km-long segment of the MCG fault system (Brabb et al., 1971; Herd, 1977). We suspect that this eastward displacement of epicenters from the fault trace is an artifact and reflects imperfect modeling of lateral crustal inhomogeneity. Detailed crustal refraction studies currently in progress may resolve this question.

Longitudinal and transverse cross sections (Fig. 4) show that the aftershocks cluster within a vertical section with an apparent width of about 2 km. However, the actual width of the zone is probably narrower because location errors tend to disperse the foci. The cross-sections also suggest that the foci concentrate at 2 depths; between 3 to 4 km and between about 6 to 11 km. The length of the aftershock zone is difficult to define from these data, as aftershocks appear along at least 30 km of the MCG fault system. The continuous zone of aftershock foci has a length of about 15 km (Fig. 4a).

Focal mechanisms for 21 aftershocks are consistent with right lateral strike-slip faulting on the MCG fault system. The focal mechanism for the largest aftershock (Fig. 5b) is significantly different in nodal plane strike than that of the main shock. In fact, the difference in strike of these 2 events approximately spans the range in strike of the aftershock focal mechanisms thus far determined. This range in strike suggests a complex strain release process. P and T axes (Fig. 6) generally suggest a consistent N-NE to S-SW compression of this area. The measured range in strike is real. However, the range in fault plane dips, i.e. the dip of the T and P axes, may be an artifact of first-motion data. For example, the first motion data of the foreshock can accommodate a range of planes similar in strike but with different dips (Fig. 7). This lack of control probably accounts for most of the range of nodal plane dips.

Two small clusters of epicenters lie significantly westward from the main aftershock trend (Fig. 3). The cluster closest to the main shock (labeled B in Figure 3) locates near the Tassajara fault (Brabb et. al., 1971). Focal mechanisms for these events show right-lateral strike slip motion on a plane striking approximately N 30° W which is consistent with observed offset on the Tassajara fault. However, an alternative interpretation is suggested by the linear E-W alignment of the epicenters. These events could result from left-lateral strike-slip movement on an unrecognized fault. The other cluster (labeled C in Figure 3), near the southern end of the aftershock trend, locates between the main branch and a subsidiary branch of the Las Positas fault. Bonilla et al. (1980) reported surface displacement along the Las Positas fault, and focal mechanisms of these events are consistent with the observed sense of motion on a fault that parallels the trend of the Las Positas fault.

The magnitude-frequency relationship for the Livermore Valley sequence is shown in Figure 8. The graph suggests that our catalog is complete to approximately the $M = 1.6$ level. In addition, the graph has a noticeable step at approximately $M = 3.5$. The maximum likelihood estimate for b is 0.82 using 282 events with $M \geq 1.6$.

The aftershock production rate per unit time, $N(t)$, commonly follows the modified Omori formula

$$N(t) = \frac{K}{(t+c)^p}$$

where K , c and p are constants (Utsu, 1961). This relationship and its special case of $c = 0$ (used here) have been employed by many authors (e.g. Mogi, 1963; Utsu, 1961, 1969; Page, 1968) and the reported values of p range from 0.9 to 1.9 with p -values most frequently between 1.0 and 1.4. Figure 9 shows the event rate for this earthquake sequence. After the first 0.2 days the frequency of aftershocks decays in accord with the above inverse power law with $p = 1.3$. Following Page (1968), the higher decay rate at the beginning of the sequence may be attributed to incompleteness in the data. This occurs when the smaller shocks are obscured by larger ones.

Discussion

The Livermore Valley earthquake sequence of January and February 1980 occurred along the Marsh Creek-Greenville fault system. The focal mechanisms of the main shock and aftershocks are consistent with right-lateral strike-slip movement on the MCG fault system. Subsidiary activity also occurred near the Tassajara and Las Positas faults. Focal mechanisms of the events located near the Tassajara and Las Positas faults are also consistent with geologic field mapping data for these faults.

Fresh surface displacement, documented by Bonilla et al. (1980), begins approximately 9 km southeast of the main shock epicenter and continues intermittently to the southeast for 6.2 km. We could speculate that rupture propagated continuously to the surface in a southeast direction from the main shock hypocenter, intersecting the surface only at the recognized breaks. However, the distribution of hypocenters shows no obvious shallowing with distance away from the main shock (Fig. 4). Rather, the shallow activity is largely restricted to the immediate area above the main shock area where no surface displacement was observed. Thus, the surface displacement may not be continuously connected to the rupture at depth, but may be sympathetic in origin. Movement within the Las Positas fault zone may also have been sympathetic. Sympathetic displacements on faults that lie at distances of up to 70 km from the causative earthquake have been reported for several other earthquakes along the San Andreas system (Allen and others, 1972; King and others, 1977).

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APPENDIX: CATALOG OF EARTHQUAKES FOR
THE LIVERMORE VALLEY JANUARY 24-FEBRUARY 26, 1980

Earthquakes are listed chronologically in this APPENDIX.

The following data are given for each event:

1. Origin time in Coordinated Universal Time (UTC): date, hour (HR), minute (MN), and second (SEC). To convert to Pacific Standard Time (PST), subtract eight hours.
2. Epicenter in degrees and minutes of north latitude (LAT N) and west longitude (LONG W).
3. DEPTH, depth of focus in kilometers.
4. MAG, coda magnitude of the earthquake. If "*" follows the magnitude, it indicates the magnitude calculated by J. Eaton as discussed in the text. If "B" follows the magnitude, it indicates the magnitude was calculated by the University of California Seismographic Station, Berkeley.
5. NO, number of P- and S-arrivals used in locating earthquake.
6. GAP, largest azimuthal separation in degrees between stations.
7. DMIN, epicentral distance in kilometers to the nearest station.
8. RMS, root-mean-square error of the time residuals:

$$RMS = \sqrt{\sum_i R_i^2 / NO}$$

where R_i is the observed seismic-wave arrival time minus the computed time at the i^{th} station.

9. ERH, standard error of the epicenter in kilometers:

$$ERH = \sqrt{SDX^2 + SDY^2}$$

where SDX and SDY are the standard errors in latitude and longitude, respectively, of the epicenter.

10. ERZ, standard error of the depth in kilometers.
11. Q, solution quality of the hypocenter. This measure is intended to indicate the general reliability of each solution.

<u>Q</u>	<u>Epicenter</u>	<u>Focal Depth</u>
A	excellent	good
B	good	fair
C	fair	poor
D	poor	poor

Q is based on both the nature of the station distribution with respect to the earthquake and the statistical measure of the solution. These two factors are each rated independently according to the following schemes.

Station Distribution

	<u>NO</u>	<u>GAP</u>	<u>DMIN</u>
A	≥ 6	≤ 90	$\leq$ DEPTH or 5 km
B	≥ 6	≤ 135	$\leq 2 \times$ DEPTH or 10 km
C	≥ 6	≤ 180	≤ 50 km
D	Others		

Statistical Measures

	<u>RMS (sec)</u>	<u>ERH (km)</u>	<u>ERZ (km)</u>
A	< 0.15	< 1.0	< 2.0
B	< 0.30	< 2.5	< 5.0
C	< 0.50	< 5.0	
D	Others		

Q is taken as the average of the ratings from the two schemes, i.e., an A and a C yield a B, and two B's yield a B. When the two ratings are only one level apart the lower one is used, i.e., an A and a B yield a B.

12. QUADRANGLE, for earthquakes between 37 35.0' and 37 55.0' N latitude and 121 35.0' and 121 55.0' W longitude, QUADRANGLE indicates the name of the U.S. Geological Survey 7.5' quadrangle in which the epicenter is located.

LIVERMORE VALLEY EARTHQUAKES JANUARY 24 - FEBRUARY 26, 1980

1980	HR	MIN	SEC	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	Q	QUADRANGLE	
JAN	24	18	58	42.4	37-49.6	121-47.1	7.1	2.5	19	146	2.3	0.13	0.6	0.8	B	TASSAJARA
	24	19	0	9.7	37-49.6	121-47.2	7.6	5.9*	19	145	2.2	0.12	0.5	0.7	B	TASSAJARA
	24	19	1	2.2	37-48.2	121-45.8	3.1	5.2B	8	154	3.6	0.12	0.8	1.2	B	TASSAJARA
	24	19	1	45.2	37-49.8	121-44.6	1.7	4.2B	7	253	5.6	0.21	4.9	2.9	D	BYRON HOT SPRINGS
	24	19	3	19.2	37-50.1	121-48.3	1.4	4.8B	6	165	12.0	0.05	0.6	0.9	B	TASSAJARA
	24	19	4	54.5	37-49.8	121-47.3	6.5	2.2	14	172	2.4	0.09	0.5	0.6	B	TASSAJARA
	24	19	5	24.8	37-50.2	121-47.1	3.4	1.6	10	193	3.3	0.19	1.5	1.5	C	TASSAJARA
	24	19	5	41.9	37-50.2	121-48.1	1.5	2.3	15	166	2.3	0.16	0.7	0.8	C	TASSAJARA
	24	19	6	12.0	37-49.9	121-47.6	0.1	1.6	8	188	11.8	0.06	0.5	3.2	C	TASSAJARA
	24	19	7	20.6	37-49.9	121-47.7	6.2	1.7	13	187	2.3	0.16	1.1	1.6	C	TASSAJARA
	24	19	7	48.8	37-50.0	121-47.8	5.8	1.7	12	180	2.5	0.19	1.4	2.1	C	TASSAJARA
	24	19	9	28.0	37-50.1	121-47.8	3.3	1.5	16	169	2.7	0.13	0.6	0.7	B	TASSAJARA
	24	19	11	42.6	37-43.2	121-39.0	0.2	1.1	11	219	16.3	0.09	0.5	2.7	C	ALTAMONT
	24	19	12	42.1	37-50.4	121-47.8	3.1	2.7	17	177	3.2	0.12	0.6	0.7	B	TASSAJARA
	24	19	13	35.7	37-50.6	121-47.5	0.1	2.1	10	187	12.7	0.14	1.0	5.1	D	TASSAJARA
	24	19	14	22.2	37-50.6	121-47.8	2.0	0.9	12	168	3.6	0.14	0.9	1.1	B	TASSAJARA
	24	19	14	36.4	37-49.9	121-47.6	6.1	1.5	14	170	2.3	0.17	0.9	1.2	C	TASSAJARA
	24	19	15	54.9	37-47.9	121-45.7	6.3	1.4	14	185	3.9	0.12	0.7	0.8	C	TASSAJARA
	24	19	18	30.2	37-46.8	121-44.4	5.9	1.3	13	193	6.5	0.13	0.9	1.6	C	BYRON HOT SPRINGS
	24	19	18	58.8	37-50.2	121-48.0	0.1	1.3	14	167	12.2	0.13	0.6	3.1	C	TASSAJARA
	24	19	19	20.6	37-50.3	121-47.6	2.8	1.2	12	170	3.1	0.14	0.8	0.8	B	TASSAJARA
	24	19	20	16.3	37-50.6	121-48.3	3.0	1.3	13	163	3.5	0.14	0.8	1.0	B	TASSAJARA
	24	19	22	17.0	37-50.4	121-48.3	3.7	1.7	16	161	3.3	0.14	0.7	0.8	B	TASSAJARA
	24	19	23	44.8	37-47.1	121-45.8	10.8	1.2	4	225	8.8	0.01			C	TASSAJARA
	24	19	26	4.6	37-51.0	121-48.0	3.8	2.3	17	180	4.3	0.12	0.6	0.7	B	TASSAJARA
	24	19	29	12.6	37-51.1	121-48.3	3.2	1.5	14	163	4.4	0.15	0.7	1.0	B	TASSAJARA
	24	19	30	4.9	37-50.0	121-48.3	3.7	1.9	14	174	2.4	0.12	0.7	0.6	B	TASSAJARA
	24	19	30	53.1	37-49.9	121-47.8	2.9	2.2	18	169	2.4	0.13	0.6	0.6	B	TASSAJARA
	24	19	31	56.4	37-50.2	121-47.3	6.2	1.0	11	172	3.1	0.15	0.9	1.3	C	TASSAJARA
	24	19	32	15.4	37-50.5	121-48.0	7.6	1.2	14	167	3.3	0.20	1.1	1.7	C	TASSAJARA
	24	19	33	17.5	37-38.7	121-36.7	1.6	1.5	10	234	21.9	0.14	1.6	5.6	D	MIDWAY
	24	19	34	4.5	37-47.7	121-45.9	6.6	1.3	9	189	3.8	0.15	1.2	1.2	C	TASSAJARA
	24	19	40	21.8	37-50.2	121-46.8	0.2	1.3	5	195	12.8	0.05	0.8	3.7	C	TASSAJARA
	24	19	40	46.3	37-50.3	121-47.6	5.1	1.0	7	186	3.1	0.41	4.6	5.2	D	TASSAJARA
	24	19	43	18.0	37-49.3	121-47.6	6.4	2.6	18	171	2.2	0.11	0.5	0.6	B	TASSAJARA
	24	19	47	57.6	37-49.8	121-47.9	6.2	1.3	11	168	2.1	0.15	0.9	1.2	B	TASSAJARA
	24	19	49	24.5	37-50.0	121-47.8	6.5	1.9	16	169	2.5	0.10	0.5	0.7	B	TASSAJARA
	24	19	50	37.9	37-50.4	121-47.9	6.2	1.2	12	168	3.2	0.17	0.9	1.3	C	TASSAJARA
	24	19	51	17.5	37-50.0	121-47.8	7.4	2.6	17	169	2.4	0.13	0.6	0.9	B	TASSAJARA
	24	19	52	35.7	37-51.1	121-48.2	1.4	2.0	13	165	11.3	0.10	0.5	0.6	B	TASSAJARA
	24	19	53	19.8	37-49.8	121-47.6	3.4	1.1	11	170	2.2	0.16	1.0	0.9	C	TASSAJARA
	24	19	54	22.5	37-50.0	121-48.0	7.5	2.3	17	168	2.4	0.11	0.6	0.7	B	TASSAJARA
	24	19	55	11.3	37-50.7	121-48.2	5.9	2.0	13	179	3.8	0.14	0.8	1.1	B	TASSAJARA
	24	19	56	5.2	37-50.3	121-48.6	8.9	3.1	18	153	3.0	0.11	0.5	0.5	B	TASSAJARA
	24	19	57	56.1	37-50.7	121-48.2	5.9	1.3	10	165	3.7	0.13	0.8	1.3	B	TASSAJARA

LIVERMORE VALLEY EARTHQUAKES JANUARY 24 - FEBRUARY 26, 1980 (CONTINUED)

1980	HR	MIN	SEC	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	Q	QUADRANGLE
JAN	24	19	58	9.1	37-45.8	121-43.6	8.8	2.8	18	164	8.6	0.10	0.5	0.5	B BYRON HOT SPRINGS
	24	20	0	9.0	37-50.3	121-48.4	6.7	1.1	9	158	3.0	0.12	0.8	1.1	B TASSAJARA
	24	20	1	13.5	37-50.1	121-47.9	6.8	1.8	15	168	2.7	0.11	0.6	0.6	B TASSAJARA
	24	20	4	59.4	37-50.1	121-47.5	0.8	1.1	4	188	12.2	0.00			C TASSAJARA
	24	20	6	16.5	37-51.7	121-48.4	3.3	2.2	16	158	5.6	0.09	0.4	0.6	B TASSAJARA
	24	20	7	6.4	37-50.3	121-48.1	8.1	1.8	14	166	3.0	0.18	1.0	1.4	C TASSAJARA
	24	20	10	51.5	37-50.1	121-47.7	2.8	1.2	12	169	2.8	0.18	1.0	1.0	C TASSAJARA
	24	20	12	58.9	37-50.2	121-47.8	3.1	1.7	15	169	2.9	0.12	0.6	0.7	B TASSAJARA
	24	20	15	15.2	37-46.5	121-44.5	9.0	1.7	14	192	6.6	0.09	0.6	0.5	C BYRON HOT SPRINGS
	24	20	16	18.1	37-51.5	121-48.5	3.0	2.0	13	156	5.3	0.04	0.2	0.3	B TASSAJARA
	24	20	18	22.3	37-50.5	121-48.5	3.5	2.3	15	171	3.5	0.10	0.6	0.6	B TASSAJARA
	24	20	19	41.3	37-47.0	121-44.7	2.9	1.6	10	191	5.9	0.10	0.8	0.7	C BYRON HOT SPRINGS
	24	20	24	8.3	37-49.1	121-46.2	0.5	1.3	6	229	15.9	0.08	1.4	5.6	D TASSAJARA
	24	20	25	32.1	37-50.9	121-48.0	2.2	1.6	7	210	11.7	0.08	1.1	1.3	C TASSAJARA
	24	20	28	27.3	37-49.9	121-47.9	6.3	1.3	13	168	2.2	0.11	0.6	0.7	B TASSAJARA
	24	20	31	8.0	37-50.3	121-48.6	9.3	2.5	17	152	3.1	0.10	0.5	0.5	B TASSAJARA
	24	20	31	44.2	37-50.0	121-48.2	8.9	1.3	10	167	2.4	0.07	0.7	0.6	B TASSAJARA
	24	20	33	27.8	37-50.6	121-48.2	3.1	1.4	12	165	3.5	0.15	0.8	1.1	C TASSAJARA
	24	20	36	1.1	37-49.4	121-47.3	10.3	1.4	12	173	14.3	0.11	0.9	0.8	B TASSAJARA
	24	20	37	43.3	37-50.1	121-47.8	3.1	2.1	17	169	2.8	0.12	0.5	0.6	B TASSAJARA
	24	20	39	11.3	37-51.0	121-48.4	5.8	1.8	16	159	4.3	0.12	0.6	0.9	B TASSAJARA
	24	20	42	6.7	37-46.5	121-44.2	8.9	2.2	15	194	7.0	0.08	0.5	0.4	C BYRON HOT SPRINGS
	24	20	43	32.4	37-50.1	121-48.3	8.4	1.4	13	163	2.6	0.10	0.5	0.7	B TASSAJARA
	24	20	45	11.2	37-42.5	121-39.9	0.6	1.3	12	216	15.2	0.08	0.6	3.3	C ALTAMONT
	24	20	49	1.0	37-50.5	121-48.1	3.7	1.4	13	166	3.3	0.11	0.6	0.7	B TASSAJARA
	24	20	50	3.6	37-45.4	121-42.4	7.4	1.6	16	204	10.5	0.12	0.8	1.2	C BYRON HOT SPRINGS
	24	20	51	13.0	37-51.1	121-48.0	3.3	2.8	18	166	4.5	0.11	0.5	0.7	B TASSAJARA
	24	20	52	33.5	37-50.3	121-48.5	6.8	1.0	11	154	3.0	0.15	1.0	1.2	B TASSAJARA
	24	20	54	10.7	37-50.1	121-48.6	8.0	1.3	12	152	2.7	0.07	0.4	0.6	B TASSAJARA
	24	21	0	14.4	37-50.8	121-48.1	5.1	2.1	14	165	4.0	0.11	0.6	1.2	B TASSAJARA
	24	21	0	54.6	37-45.6	121-42.8	5.4	1.3	9	202	9.7	0.18	1.8	6.0	D BYRON HOT SPRINGS
	24	21	10	46.4	37-49.4	121-46.8	3.0	1.1	9	176	2.4	0.17	1.2	1.2	C TASSAJARA
	24	21	21	22.1	37-49.6	121-47.9	3.5	2.0	10	181	1.7	0.12	0.9	0.7	C TASSAJARA
	24	21	22	22.0	37-50.0	121-47.6	2.9	2.1	17	170	2.6	0.13	0.6	0.6	B TASSAJARA
	24	21	24	25.0	37-50.2	121-48.6	3.1	2.0	14	166	2.9	0.15	0.8	0.9	C TASSAJARA
	24	21	38	22.2	37-50.2	121-48.2	3.2	1.2	14	164	2.8	0.15	0.8	0.9	C TASSAJARA
	24	21	43	46.9	37-49.9	121-47.7	2.9	1.3	12	170	2.3	0.17	1.0	0.9	C TASSAJARA
	24	21	53	33.9	37-39.3	121-41.3	8.7	1.7	8	234	20.1	0.06	0.9	0.6	C ALTAMONT
	24	21	58	29.5	37-47.7	121-45.3	6.0	2.0	18	187	4.6	0.14	0.7	0.9	C TASSAJARA
	24	22	0	46.8	37-50.4	121-47.8	3.7	1.2	14	168	3.2	0.10	0.5	0.6	B TASSAJARA
	24	22	1	8.3	37-50.9	121-48.0	1.3	1.3	12	168	4.1	0.15	0.8	1.0	B TASSAJARA
	24	22	4	33.1	37-50.4	121-47.7	5.2	1.8	17	169	3.3	0.13	0.6	1.1	B TASSAJARA
	24	22	9	9.2	37-45.6	121-42.8	7.2	1.5	15	202	11.2	0.11	0.8	1.3	C BYRON HOT SPRINGS
	24	22	12	46.1	37-50.4	121-47.9	2.8	1.8	16	168	3.3	0.15	0.7	0.8	C TASSAJARA
	24	22	13	26.4	37-50.5	121-48.1	3.9	1.9	16	166	3.3	0.12	0.6	0.6	B TASSAJARA

LIVERMORE VALLEY EARTHQUAKES JANUARY 24 - FEBRUARY 26, 1980 (CONTINUED)

1930	HR	MN	SEC	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	Q	QUADRANGLE	
JAN	24	22	13	35.5	37-49.8	121-43.3	3.8	1.9	6	235	7.4	0.06	1.8	1.3	C	BYRON HOT SPRINGS
	24	22	14	3.2	37-51.1	121-48.1	3.8	2.0	16	165	4.5	0.11	0.5	0.6	B	TASSAJARA
	24	22	15	1.7	37-48.0	121-45.9	9.5	1.9	9	189	3.6	0.04	0.4	0.3	C	TASSAJARA
	24	22	19	29.0	37-50.2	121-47.9	3.1	1.8	17	168	2.9	0.12	0.6	0.7	B	TASSAJARA
	24	22	21	10.8	37-51.1	121-48.1	3.3	2.1	16	165	4.6	0.11	0.5	0.7	B	TASSAJARA
	24	22	24	15.0	37-50.4	121-47.9	2.9	2.2	18	167	3.1	0.13	0.6	0.6	B	TASSAJARA
	24	22	26	31.7	37-50.0	121-47.3	2.7	2.3	18	172	2.8	0.12	0.6	0.6	B	TASSAJARA
	24	22	32	12.3	37-50.5	121-48.0	2.8	1.4	14	166	3.3	0.11	0.6	0.6	B	TASSAJARA
	24	22	32	30.6	37-51.1	121-48.0	3.1	2.3	17	165	4.5	0.11	0.5	0.7	B	TASSAJARA
	24	22	37	9.3	37-50.4	121-47.8	1.6	1.4	13	168	3.3	0.10	0.5	0.5	B	TASSAJARA
	24	22	38	3.0	37-50.4	121-48.1	3.4	2.6	17	167	3.2	0.13	0.6	0.7	B	TASSAJARA
	24	22	42	1.6	37-50.2	121-48.4	8.9	2.1	17	157	2.8	0.10	0.5	0.5	B	TASSAJARA
	24	22	47	36.3	37-50.4	121-48.1	3.5	1.4	14	166	3.2	0.16	0.8	0.9	C	TASSAJARA
	24	22	53	26.8	37-47.3	121-44.3	7.1	1.5	14	193	6.2	0.08	0.5	0.7	C	BYRON HOT SPRINGS
	24	23	32	15.0	37-51.1	121-47.8	3.0	1.2	11	173	4.5	0.14	0.8	1.3	B	TASSAJARA
	24	23	33	33.1	37-50.4	121-47.8	2.3	1.7	11	168	3.3	0.24	1.4	1.7	C	TASSAJARA
	24	23	38	22.5	37-43.2	121-40.9	0.6	1.5	11	211	13.6	0.11	0.6	3.5	C	ALTAMONT
	24	23	40	5.1	37-50.6	121-46.5	2.9	1.7	16	178	4.3	0.09	0.5	0.5	B	TASSAJARA
	24	23	46	1.5	37-50.6	121-47.4	5.2	2.6	18	171	3.7	0.11	0.5	0.9	B	TASSAJARA
	24	23	56	56.4	37-50.9	121-48.3	3.4	1.2	11	162	4.1	0.17	0.9	1.3	C	TASSAJARA
	25	0	13	38.7	37-50.7	121-48.1	6.0	1.5	16	166	3.7	0.17	0.8	1.2	C	TASSAJARA
	25	0	15	9.0	37-50.6	121-47.6	2.9	2.9	18	169	3.7	0.12	0.6	0.6	B	TASSAJARA
	25	0	23	33.4	37-50.3	121-47.9	3.7	1.4	13	168	3.0	0.11	0.6	0.6	B	TASSAJARA
	25	0	25	48.5	37-49.7	121-46.4	6.2	1.5	10	179	3.2	0.22	1.6	1.8	C	TASSAJARA
	25	0	28	33.3	37-50.7	121-48.6	3.4	2.2	13	153	3.7	0.13	0.7	0.9	B	TASSAJARA
	25	0	32	52.8	37-50.4	121-48.0	3.4	1.7	16	167	3.2	0.13	0.7	0.8	B	TASSAJARA
	25	0	49	43.0	37-51.3	121-48.3	2.5	1.5	15	162	4.8	0.13	0.6	0.7	B	TASSAJARA
	25	0	51	31.0	37-51.1	121-48.2	3.0	1.5	11	165	4.4	0.15	0.9	1.0	C	TASSAJARA
	25	0	56	6.7	37-45.0	121-45.2	0.1	1.5	9	192	7.6	0.19	0.9	4.9	C	LIVERMORE
	25	0	56	32.1	37-51.1	121-48.0	3.0	2.53	18	166	4.5	0.12	0.5	0.7	B	TASSAJARA
	25	1	3	36.9	37-48.3	121-46.0	6.3	1.6	15	182	3.2	0.13	0.7	0.8	C	TASSAJARA
	25	1	8	2.2	37-51.1	121-47.9	3.2	1.5	16	166	4.5	0.13	0.6	0.8	B	TASSAJARA
	25	1	18	44.0	37-50.3	121-47.8	3.2	2.7	18	168	3.1	0.13	0.6	0.7	B	TASSAJARA
	25	1	23	17.3	37-50.3	121-48.0	3.6	1.4	13	167	2.9	0.10	0.6	0.6	B	TASSAJARA
	25	1	28	3.0	37-50.0	121-47.9	5.9	1.7	15	168	2.4	0.12	0.6	0.9	B	TASSAJARA
	25	1	31	4.4	37-50.2	121-48.9	0.6	1.1	12	142	3.0	0.18	0.9	1.0	C	TASSAJARA
25	1	31	12.2	37-50.0	121-47.8	3.1	2.1	14	136	2.5	0.12	0.6	0.7	B	TASSAJARA	
25	1	48	7.0	37-50.2	121-47.1	2.7	2.8	19	141	3.1	0.16	0.7	0.7	C	TASSAJARA	
25	1	50	19.0	37-50.0	121-48.0	2.9	1.4	14	168	2.5	0.14	0.7	0.7	B	TASSAJARA	
25	1	51	20.3	37-50.4	121-47.9	3.0	1.6	13	168	3.2	0.13	0.7	0.7	B	TASSAJARA	
25	1	52	14.9	37-50.2	121-47.8	2.9	1.5	14	169	2.9	0.14	0.7	0.7	B	TASSAJARA	
25	1	52	43.1	37-44.1	121-41.0	4.4	1.4	7	226	13.4	0.02	0.3	0.3	C	ALTAMONT	
25	1	54	2.1	37-50.3	121-48.0	3.9	1.9	16	167	2.9	0.14	0.7	0.7	B	TASSAJARA	
25	2	34	35.3	37-50.1	121-48.4	9.1	1.4	15	155	2.6	0.10	0.5	0.6	B	TASSAJARA	
25	2	58	22.2	37-47.0	121-44.8	3.2	1.8	18	191	5.9	0.11	0.6	0.7	C	BYRON HOT SPRINGS	

LIVERMORE VALLEY EARTHQUAKES JANUARY 24 - FEBRUARY 26, 1980 (CONTINUED)

1980	HR	MM	SEC	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	Q	QUADRANGLE
JAN 25	3	2	6.8	37-43.3	121-40.4	0.6	2.0	13	213	14.3	0.12	0.6	3.6	C	ALTAMONT
25	3	13	2.3	37-50.3	121-47.7	2.9	2.3	17	169	3.1	0.13	0.6	0.6	B	TASSAJARA
25	3	14	0.9	37-50.2	121-47.6	3.2	2.5	18	170	2.9	0.12	0.6	0.6	B	TASSAJARA
25	3	16	49.2	37-50.4	121-47.9	6.1	2.0	14	167	12.3	0.14	0.7	1.9	B	TASSAJARA
25	3	23	48.0	37-50.9	121-48.4	3.6	2.7	10	174	4.1	0.09	0.7	0.8	B	TASSAJARA
25	3	26	16.5	37-48.3	121-45.4	8.4	1.4	14	187	4.2	0.10	0.6	0.8	C	TASSAJARA
25	3	27	55.2	37-50.9	121-47.7	3.2	1.5	13	169	4.2	0.10	0.5	0.8	B	TASSAJARA
25	3	30	11.6	37-51.1	121-48.2	6.4	1.2	13	165	4.4	0.18	0.9	1.5	C	TASSAJARA
25	3	38	10.9	37-51.1	121-48.0	3.0	1.2	13	166	4.4	0.13	0.7	1.1	B	TASSAJARA
25	3	42	19.7	37-51.1	121-48.1	3.1	1.4	15	165	4.5	0.11	0.5	0.8	B	TASSAJARA
25	4	0	50.7	37-43.1	121-40.3	1.3	1.4	16	165	14.5	0.10	0.5	0.9	B	ALTAMONT
25	4	6	25.2	37-51.2	121-48.0	3.1	3.3	17	165	4.6	0.11	0.5	0.7	B	TASSAJARA
25	4	26	32.3	37-50.4	121-47.8	2.8	2.7	18	136	3.2	0.12	0.5	0.6	B	TASSAJARA
25	4	27	21.9	37-50.2	121-48.0	3.1	2.1	15	167	2.8	0.12	0.6	0.7	B	TASSAJARA
25	4	28	14.7	37-50.2	121-48.1	2.6	1.5	16	167	2.8	0.14	0.6	0.7	B	TASSAJARA
25	4	29	23.8	37-50.2	121-48.2	3.0	1.5	14	179	2.9	0.12	0.7	0.6	B	TASSAJARA
25	4	33	54.2	37-51.3	121-48.4	3.1	1.9	16	159	4.9	0.12	0.5	0.9	B	TASSAJARA
25	4	47	38.6	37-50.3	121-47.8	3.2	1.5	14	169	3.1	0.17	0.9	1.0	C	TASSAJARA
25	4	51	30.5	37-51.2	121-48.1	3.2	1.6	17	165	4.7	0.12	0.5	0.8	B	TASSAJARA
25	5	12	43.2	37-50.3	121-46.8	6.3	4.3*	12	90	3.2	0.15	0.7	1.0	B	TASSAJARA
25	5	21	47.7	37-51.3	121-47.0	4.3	3.0	7	236	4.5	0.03	0.6	0.3	C	TASSAJARA
25	5	24	36.6	37-51.1	121-47.7	5.0	4.2	14	97	4.5	0.14	0.6	0.8	B	TASSAJARA
25	5	29	45.2	37-50.7	121-48.0	3.1	3.9	14	93	3.7	0.10	0.4	0.8	B	TASSAJARA
25	5	34	16.6	37-51.6	121-49.2	0.2	1.4	14	142	5.7	0.09	0.4	2.4	C	TASSAJARA
25	5	37	55.8	37-47.2	121-44.7	8.7	1.3	6	235	10.1	0.09	1.9	2.9	C	BYRON HOT SPRINGS
25	5	57	14.8	37-50.5	121-47.6	3.0	1.2	12	184	3.5	0.12	0.7	0.8	C	TASSAJARA
25	6	9	32.5	37-49.5	121-47.5	6.3	1.7	15	171	1.8	0.12	0.6	0.8	B	TASSAJARA
25	6	28	15.7	37-46.8	121-44.2	7.5	1.4	15	194	10.4	0.08	0.5	0.7	C	BYRON HOT SPRINGS
25	6	29	15.4	37-50.7	121-47.0	5.8	2.7	12	96	4.1	0.13	0.7	1.0	B	TASSAJARA
25	6	30	44.7	37-50.7	121-48.6	0.4	1.8	17	153	3.8	0.12	0.4	0.7	B	TASSAJARA
25	6	54	19.3	37-49.9	121-47.4	3.1	1.8	20	78	2.6	0.10	0.3	0.5	A	TASSAJARA
25	7	6	8.7	37-49.5	121-47.5	6.6	1.3	14	172	1.8	0.10	0.6	0.6	B	TASSAJARA
25	7	11	43.5	37-50.5	121-47.6	2.9	1.5	14	170	3.5	0.16	0.8	0.9	C	TASSAJARA
25	7	20	18.9	37-45.3	121-43.5	8.2	2.0	11	152	1.1	0.09	0.6	0.5	B	BYRON HOT SPRINGS
25	7	22	18.2	37-50.9	121-48.4	3.1	1.7	16	159	4.1	0.12	0.5	0.8	B	TASSAJARA
25	7	22	40.2	37-45.3	121-44.2	7.9	2.3	9	182	0.6	0.02	0.2	0.2	C	BYRON HOT SPRINGS
25	7	24	45.4	37-49.9	121-47.7	6.4	1.3	17	170	2.3	0.15	0.7	0.8	B	TASSAJARA
25	7	29	27.3	37-50.5	121-48.0	3.0	2.5	12	92	3.4	0.13	0.6	1.0	B	TASSAJARA
25	7	31	57.5	37-50.2	121-46.7	3.4	2.1	12	93	3.5	0.12	0.6	0.8	B	TASSAJARA
25	7	33	19.3	37-52.3	121-49.0	0.2	1.6	16	146	6.3	0.11	0.4	2.6	C	TASSAJARA
25	7	39	30.1	37-47.2	121-45.0	9.4	1.4	16	189	5.4	0.12	0.7	0.7	C	BYRON HOT SPRINGS
25	7	39	58.9	37-50.9	121-47.5	5.1	1.9	17	170	4.2	0.15	0.7	1.5	C	TASSAJARA
25	7	45	59.8	37-50.5	121-48.2	3.0	3.2	11	91	3.4	0.09	0.5	0.5	B	TASSAJARA
25	7	53	39.7	37-50.4	121-47.9	2.9	2.6	12	91	3.2	0.10	0.5	0.5	B	TASSAJARA
25	8	20	43.7	37-49.7	121-47.2	6.4	1.8	10	77	8.8	0.10	0.6	1.9	B	TASSAJARA

LIVERMORE VALLEY EARTHQUAKES JANUARY 24 - FEBRUARY 26, 1980 (CONTINUED)

1930	HR	MIN	SEC	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	Q	QUADRANGLE	
JAN	25	8	39	16.1	37-50.4	121-47.6	1.7	1.5	7	80	10.2	0.06	0.4	0.6	B	TASSAJARA
	25	8	43	36.6	37-45.8	121-43.2	9.3	2.3	11	175	1.4	0.11	1.1	1.1	C	BYRON HOT SPRINGS
	25	8	54	6.1	37-50.1	121-47.7	0.2	1.5	9	77	9.8	0.04	0.2	1.5	B	TASSAJARA
	25	8	54	23.4	37-50.0	121-47.7	0.8	1.8	8	225	2.6	0.10	1.4	0.6	C	TASSAJARA
	25	8	55	26.6	37-50.2	121-48.2	1.6	1.9	7	236	12.1	0.12	0.6	0.5	C	TASSAJARA
	25	8	55	49.9	37-49.9	121-48.1	0.2	1.0	5	240	11.6	0.02	0.3	1.3	C	TASSAJARA
	25	9	4	38.4	37-50.8	121-47.4	4.0	2.1	15	84	4.1	0.10	0.4	0.6	A	TASSAJARA
	25	9	20	57.1	37-49.4	121-47.9	1.1	1.2	4	241	10.9	0.00			C	TASSAJARA
	25	9	22	48.1	37-50.1	121-49.5	4.6	1.1	9	165	11.1	0.03	0.2	0.2	B	TASSAJARA
	25	9	26	4.7	37-45.8	121-45.6	9.1	1.0	5	238	16.9	0.02	1.8	3.2	C	TASSAJARA
	25	9	27	11.1	37-50.1	121-48.7	1.9	0.1	5	232	11.8	0.01	0.2	0.3	C	TASSAJARA
	25	9	31	10.2	37-51.3	121-47.6	3.2	1.6	11	85	4.8	0.12	0.6	1.3	A	TASSAJARA
	25	9	39	49.1	37-48.0	121-45.6	9.1	2.1	11	85	4.9	0.09	0.7	1.2	A	TASSAJARA
	25	10	6	10.8	37-47.2	121-44.7	10.2	2.1	10	105	3.0	0.11	0.9	0.9	B	BYRON HOT SPRINGS
	25	10	9	31.7	37-47.3	121-44.7	8.0	2.4	10	104	3.1	0.13	1.3	2.2	B	BYRON HOT SPRINGS
	25	10	16	58.6	37-48.6	121-46.0	9.5	2.6	13	78	3.1	0.12	0.8	1.1	A	TASSAJARA
	25	10	22	43.8	37-50.5	121-47.5	2.5	1.9	10	81	10.3	0.08	0.4	1.1	B	TASSAJARA
	25	10	25	9.5	37-51.4	121-48.0	3.4	1.6	11	83	5.0	0.12	0.6	1.2	A	TASSAJARA
	25	10	28	57.9	37-51.5	121-46.9	8.4	1.2	6	259	5.6	0.10	3.7	3.6	D	TASSAJARA
	25	10	35	23.5	37-48.7	121-46.4	8.3	2.1	10	73	6.5	0.10	0.8	1.9	A	TASSAJARA
	25	10	37	23.2	37-50.0	121-47.6	0.3	1.5	9	110	12.1	0.15	0.7	5.3	C	TASSAJARA
	25	10	57	55.4	37-49.5	121-47.0	4.2	1.1	7	241	11.5	0.05	0.9	0.6	C	TASSAJARA
	25	11	1	25.8	37-49.2	121-46.8	7.4	-0.0	5	241	11.1	0.02	0.6	0.9	C	TASSAJARA
	25	11	2	2.4	37-49.5	121-46.6	4.7	1.1	6	244	11.8	0.09	2.0	1.6	C	TASSAJARA
	25	11	23	37.3	37-48.8	121-45.9	4.9	1.2	6	244	11.1	0.04	0.9	76.7	D	TASSAJARA
	25	11	31	3.1	37-49.8	121-47.1	6.4	1.2	11	185	2.6	0.16	1.2	1.3	C	TASSAJARA
	25	11	54	38.5	37-50.4	121-47.9	1.8	1.4	7	182	12.3	0.04	0.4	0.4	C	TASSAJARA
	25	12	2	2.0	37-51.3	121-45.1	1.1	1.6	10	199	6.6	0.16	1.4	1.2	C	TASSAJARA
	25	12	11	48.0	37-49.5	121-47.2	6.2	2.8	17	77	2.2	0.10	0.4	0.6	A	TASSAJARA
	25	12	17	11.1	37-49.3	121-46.8	5.7	1.3	7	241	11.2	0.06	1.1	3.3	C	TASSAJARA
	25	12	20	8.5	37-48.9	121-45.6	4.1	1.5	5	247	11.6	0.02	0.6	0.4	C	TASSAJARA
	25	12	25	18.3	37-49.8	121-46.4	9.8	2.0	12	220	3.3	0.10	0.9	0.6	C	TASSAJARA
	25	12	37	8.8	37-48.8	121-46.4	3.7	1.6	7	242	10.8	0.03	0.6	0.5	C	TASSAJARA
	25	12	37	30.2	37-50.3	121-47.5	0.3	1.2	5	242	12.7	0.06	1.4	4.0	C	TASSAJARA
	25	12	56	47.6	37-50.5	121-46.9	4.9	1.6	6	247	13.4	0.11	2.3		D	TASSAJARA
	25	13	7	14.3	37-50.2	121-47.3	6.4	1.5	12	168	3.1	0.14	0.9	0.9	B	TASSAJARA
	25	13	10	33.3	37-50.6	121-48.5	10.0	2.0	11	211	3.7	0.08	0.7	0.5	C	TASSAJARA
	25	13	18	24.0	37-47.3	121-45.5	8.7	1.9	11	211	4.6	0.09	1.0	0.8	C	TASSAJARA
	25	13	18	45.6	37-46.5	121-47.3	5.6	1.6	8	211	4.3	0.05	0.9	0.9	C	TASSAJARA
	25	13	39	2.5	37-50.2	121-47.6	3.2	3.6	20	79	3.0	0.09	0.3	0.5	A	TASSAJARA
	25	13	46	14.1	37-50.3	121-47.3	3.2	1.5	6	251	3.3	0.10	2.5	1.4	C	TASSAJARA
	25	13	58	44.5	37-49.7	121-47.4	7.9	1.4	7	239	2.2	0.13	2.5	2.1	D	TASSAJARA
	25	14	0	29.8	37-50.5	121-48.4	0.6	1.6	12	160	3.4	0.16	0.8	4.4	C	TASSAJARA
	25	14	3	27.7	37-50.3	121-47.4	3.6	3.3	20	80	3.2	0.13	0.4	0.6	A	TASSAJARA
	25	14	21	22.7	37-51.5	121-48.1	3.2	1.5	10	233	5.3	0.10	1.2	1.1	C	TASSAJARA

LIVERMORE VALLEY EARTHQUAKES JANUARY 24 - FEBRUARY 26, 1980 (CONTINUED)

1930	HR	MIN	SEC	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	Q	QUADRANGLE	
JAN	25	14	23	42.8	37-51.4	121-44.0	2.5	1.3	6	280	7.9	0.10	3.4	1.2	D	BYRON HOT SPRINGS
	25	14	44	26.8	37-51.6	121-48.9	0.4	2.1	10	222	5.5	0.06	0.5	1.7	C	TASSAJARA
	25	14	54	41.7	37-50.1	121-47.3	5.3	1.2	4	250	2.9	0.00			C	TASSAJARA
	25	14	55	3.9	37-52.0	121-45.0	5.1	1.3	6	276	7.7	0.09	3.4	3.2	D	TASSAJARA
	25	15	5	8.0	37-48.3	121-46.5	8.9	1.1	13	179	2.5	0.13	0.8	0.8	B	TASSAJARA
	25	15	6	8.3	37-49.7	121-47.1	3.8	2.3	12	89	2.8	0.09	0.4	0.5	A	TASSAJARA
	25	15	14	4.2	37-51.1	121-46.2	10.7	1.6	6	172	5.2	0.23	2.8	3.0	C	TASSAJARA
	25	15	31	18.3	37-49.4	121-47.4	7.4	1.7	9	99	1.7	0.09	0.6	0.6	B	TASSAJARA
	25	15	41	7.4	37-51.1	121-47.5	3.0	3.1	21	85	4.6	0.12	0.4	0.6	A	TASSAJARA
	25	15	42	35.1	37-51.0	121-47.4	4.0	2.7	11	97	4.5	0.11	0.6	0.9	B	TASSAJARA
	25	15	44	49.8	37-49.7	121-47.6	3.4	2.2	11	147	2.1	0.06	0.4	0.4	B	TASSAJARA
	25	15	53	0.5	37-49.2	121-47.5	3.4	2.4	11	83	1.4	0.10	0.5	0.5	A	TASSAJARA
	25	16	4	25.2	37-50.6	121-46.9	3.7	1.5	8	95	4.0	0.07	0.5	0.7	B	TASSAJARA
	25	17	8	59.8	37-50.9	121-47.6	3.8	2.3	11	96	4.2	0.14	0.8	1.1	B	TASSAJARA
	25	17	45	5.7	37-49.9	121-48.2	8.9	1.4	5	176	2.3	0.02	0.3	0.2	C	TASSAJARA
	25	18	11	4.3	37-48.5	121-45.8	10.3	1.7	9	82	3.5	0.05	0.4	0.2	A	TASSAJARA
	25	18	21	36.3	37-48.7	121-46.2	10.1	2.1	11	79	2.9	0.08	0.5	0.3	A	TASSAJARA
	25	18	24	52.0	37-48.6	121-46.1	10.1	2.2	11	79	3.0	0.07	0.4	0.3	A	TASSAJARA
	25	19	15	48.3	37-49.6	121-48.0	7.2	1.7	6	180	1.7	0.08	1.0	1.0	B	TASSAJARA
	25	20	20	42.0	37-44.5	121-43.0	7.6	1.5	9	161	2.7	0.09	0.7	0.6	B	ALTAMONT
	25	20	22	25.8	37-50.3	121-47.9	0.2	1.9	9	91	10.2	0.10	0.5	4.5	C	TASSAJARA
	25	20	27	51.1	37-44.7	121-42.1	7.9	1.4	9	166	3.3	0.07	0.6	0.8	B	ALTAMONT
	25	20	54	15.5	37-50.5	121-47.4	6.8	1.8	9	93	3.5	0.15	1.0	1.3	B	TASSAJARA
	25	21	50	37.6	37-48.3	121-45.8	9.8	2.1	12	77	3.5	0.03	0.2	0.1	A	TASSAJARA
	25	22	48	8.7	37-48.9	121-46.9	9.8	2.3	13	81	1.8	0.08	0.4	0.3	A	TASSAJARA
	25	22	48	48.0	37-50.9	121-47.5	3.1	2.2	10	96	4.2	0.13	0.8	1.3	B	TASSAJARA
	25	22	54	42.3	37-47.6	121-45.2	8.8	2.0	11	85	4.0	0.04	0.2	0.2	A	TASSAJARA
	25	23	5	46.4	37-49.7	121-47.5	8.7	1.6	9	95	2.1	0.10	0.6	0.8	B	TASSAJARA
	25	23	9	54.9	37-48.6	121-46.1	10.0	2.0	12	78	3.0	0.06	0.3	0.2	A	TASSAJARA
	25	23	20	57.0	37-51.2	121-49.8	0.2	1.9	11	148	5.3	0.08	0.5	3.8	C	TASSAJARA
	25	23	23	4.7	37-48.5	121-46.4	10.3	1.8	10	109	2.6	0.09	0.5	0.4	B	TASSAJARA
	25	23	23	35.4	37-48.6	121-46.2	10.3	1.9	11	78	2.9	0.07	0.4	0.3	A	TASSAJARA
	25	23	28	27.4	37-48.6	121-46.2	10.1	2.0	9	79	2.9	0.06	0.4	0.3	A	TASSAJARA
	25	23	35	23.8	37-42.6	121-42.1	0.6	1.5	6	176	15.3	0.07	0.6	3.8	C	ALTAMONT
	25	23	44	23.0	37-51.2	121-47.9	3.1	2.4	12	97	4.7	0.11	0.5	1.1	B	TASSAJARA
	25	23	52	13.9	37-46.0	121-43.2	9.0	1.6	9	159	8.8	0.10	0.8	0.9	B	BYRON HOT SPRINGS
	26	0	14	46.4	37-50.1	121-48.5	7.6	1.0	11	155	2.7	0.15	0.9	1.4	B	TASSAJARA
	26	0	17	51.1	37-51.4	121-48.5	2.3	1.1	11	156	5.1	0.13	0.7	0.9	B	TASSAJARA
	26	0	27	39.0	37-49.3	121-47.2	9.0	1.2	12	174	1.9	0.11	0.7	0.6	B	TASSAJARA
	26	0	36	46.3	37-43.1	121-42.1	0.9	1.6	12	126	5.6	0.28	1.6	13.4	C	ALTAMONT
	26	1	51	18.0	37-50.0	121-37.8	1.8	1.7	10	225	1.1	0.60	6.4	3.6	D	BYRON HOT SPRINGS
	26	1	56	31.7	37-44.5	121-43.3	8.2	1.7	11	156	2.4	0.12	0.7	0.7	B	ALTAMONT
	26	2	15	50.9	37-49.7	121-47.3	3.6	2.2	12	87	2.3	0.10	0.5	0.5	A	TASSAJARA
	26	2	49	54.7	37-49.2	121-46.8	10.3	1.8	10	83	2.1	0.06	0.4	0.4	A	TASSAJARA
	26	2	58	13.4	37-50.8	121-47.8	3.9	1.8	11	94	3.9	0.17	0.8	1.3	B	TASSAJARA

LIVERMORE VALLEY EARTHQUAKES JANUARY 24 - FEBRUARY 26, 1980 (CONTINUED)

1980	HR	MIN	SEC	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	Q	QUADRANGLE
JAN 26	3	0	21.0	37-50.9	121-47.5	4.8	1.9	13	96	4.2	0.15	0.7	0.7	B	TASSAJARA
26	3	24	23.0	37-48.7	121-46.4	9.8	1.6	10	79	2.6	0.07	0.4	0.4	A	TASSAJARA
26	3	37	27.6	37-49.3	121-47.2	3.0	1.6	10	83	1.8	0.16	0.8	0.9	B	TASSAJARA
26	4	3	26.5	37-47.1	121-44.5	9.7	1.9	12	93	6.1	0.07	0.4	0.3	B	BYRON HOT SPRINGS
26	4	12	57.6	37-48.4	121-46.6	8.0	1.1	11	148	2.3	0.11	0.6	1.0	B	TASSAJARA
26	4	13	31.9	37-49.9	121-47.1	4.8	1.5	11	89	2.8	0.13	0.7	0.6	A	TASSAJARA
26	4	33	57.0	37-45.2	121-43.5	8.4	1.6	12	110	1.2	0.08	0.4	0.4	B	BYRON HOT SPRINGS
26	5	30	39.2	37-49.7	121-46.9	3.9	1.5	8	88	2.7	0.21	1.4	1.4	B	TASSAJARA
26	6	8	13.5	37-48.7	121-46.6	9.8	1.7	16	72	2.2	0.09	0.4	0.4	A	TASSAJARA
26	6	9	12.6	37-47.9	121-45.6	8.2	0.9	11	185	4.0	0.11	0.8	1.0	C	TASSAJARA
26	6	23	43.4	37-49.7	121-47.2	9.4	2.2	13	87	2.3	0.10	0.5	0.5	A	TASSAJARA
26	6	54	7.7	37-49.4	121-47.3	6.4	1.4	9	84	1.8	0.08	0.5	0.5	A	TASSAJARA
26	6	59	55.4	37-48.7	121-46.3	10.1	2.0	13	80	2.8	0.07	0.4	0.3	A	TASSAJARA
26	7	3	11.8	37-48.5	121-46.8	9.5	1.4	9	78	2.1	0.18	1.1	1.5	B	TASSAJARA
26	7	31	22.7	37-43.0	121-50.3	1.1	1.1	6	211	13.9	0.19	2.8	3.7	D	LIVERMORE
26	7	38	32.4	37-49.8	121-47.7	7.9	1.0	12	170	2.2	0.12	0.7	1.0	B	TASSAJARA
26	7	44	32.5	37-50.3	121-47.6	10.8	1.4	9	149	3.1	0.66	4.8	3.4	D	TASSAJARA
26	8	15	37.3	37-45.6	121-44.1	8.6	1.8	12	104	0.2	0.04	0.2	0.2	B	BYRON HOT SPRINGS
26	8	24	26.7	37-45.2	121-43.0	8.9	2.1	12	114	1.8	0.07	0.3	0.3	B	BYRON HOT SPRINGS
26	8	26	15.9	37-48.7	121-46.5	9.9	1.8	13	79	2.5	0.05	0.2	0.3	A	TASSAJARA
26	8	38	38.4	37-48.8	121-46.4	9.8	1.7	11	81	2.6	0.05	0.3	0.3	A	TASSAJARA
26	8	48	7.8	37-48.1	121-45.8	10.0	1.9	13	78	3.5	0.07	0.3	0.2	A	TASSAJARA
26	8	50	21.4	37-51.0	121-47.8	3.1	0.9	12	140	4.4	0.16	0.8	1.3	C	TASSAJARA
26	9	42	45.4	37-48.7	121-46.5	10.1	1.7	11	79	2.5	0.08	0.5	0.4	A	TASSAJARA
26	10	20	20.1	37-46.7	121-44.7	10.4	1.7	10	94	2.1	0.06	0.4	0.3	B	BYRON HOT SPRINGS
26	10	36	54.6	37-39.7	121-41.1	4.0	2.0	13	133	8.5	0.13	0.6	1.2	B	ALTAMONT
26	10	40	57.9	37-39.4	121-40.9	5.5	1.1	12	154	8.0	0.12	0.7	3.0	C	ALTAMONT
26	10	55	18.0	37-39.5	121-41.0	4.2	1.8	12	133	8.2	0.13	0.7	1.0	B	ALTAMONT
26	11	48	35.2	37-50.1	121-48.5	8.5	0.8	14	135	2.5	0.16	0.8	1.1	C	TASSAJARA
26	12	2	2.9	37-47.4	121-44.9	6.5	1.6	9	155	5.3	0.07	0.4	0.6	B	BYRON HOT SPRINGS
26	13	2	22.6	37-47.9	121-44.4	5.8	1.6	10	158	4.1	0.25	1.7	1.8	C	BYRON HOT SPRINGS
26	13	42	53.8	37-43.2	121-41.3	0.2	2.0	13	132	6.2	0.08	0.4	2.2	B	ALTAMONT
26	15	1	7.8	37-47.9	121-45.8	2.4	1.5	7	219	9.8	0.05	1.1	1.1	C	TASSAJARA
26	15	30	33.7	37-47.7	121-45.1	5.0	1.1	6	129	4.8	0.14	1.3	1.5	B	TASSAJARA
26	16	1	7.5	37-46.9	121-44.8	8.6	1.4	20	92	2.6	0.14	0.5	0.6	B	BYRON HOT SPRINGS
26	16	1	40.8	37-49.6	121-47.4	8.4	1.5	14	143	2.0	0.13	0.6	0.8	B	TASSAJARA
26	16	6	22.2	37-50.2	121-47.7	8.9	1.6	17	78	2.9	0.13	0.6	0.5	A	TASSAJARA
26	16	25	57.3	37-48.4	121-46.5	9.8	1.3	18	74	2.5	0.12	0.5	0.5	A	TASSAJARA
26	18	29	9.5	37-47.7	121-45.4	10.1	1.8	22	84	4.2	0.12	0.4	0.3	A	TASSAJARA
26	18	42	19.8	37-49.7	121-47.5	8.3	1.3	17	76	2.1	0.14	0.6	0.9	A	TASSAJARA
26	18	52	33.9	37-49.9	121-47.3	3.3	1.0	13	144	2.5	0.14	0.7	0.8	B	TASSAJARA
26	19	20	25.4	37-50.9	121-48.2	3.5	1.5	19	80	4.2	0.22	0.7	1.2	B	TASSAJARA
26	19	20	59.6	37-49.8	121-47.8	2.8	2.0	21	75	2.2	0.20	0.6	0.7	B	TASSAJARA
26	19	31	57.5	37-50.1	121-47.3	3.2	1.5	19	139	2.8	0.14	0.5	0.6	B	TASSAJARA
26	19	35	41.7	37-49.8	121-47.4	7.1	1.2	16	77	2.3	0.17	0.7	1.1	B	TASSAJARA

LIVERMORE VALLEY EARTHQUAKES JANUARY 24 - FEBRUARY 26, 1980 (CONTINUED)

1980	HR	MN	SEC	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	Q	QUADRANGLE
JAN	26	19	36	37.0	37-49.8	121-47.7	3.7	1.0	13	75	2.2	0.16	0.6	0.8	B TASSAJARA
	26	20	13	2.6	37-48.7	121-46.6	9.6	1.2	14	77	10.4	0.10	0.4	0.7	B TASSAJARA
	26	20	45	11.6	37-42.2	121-52.2	7.9	1.2	18	74	4.2	0.11	0.4	0.6	A LIVERMORE
	26	20	52	13.5	37-50.1	121-48.0	3.1	2.5	21	76	2.6	0.16	0.5	0.7	B TASSAJARA
	26	20	52	56.2	37-50.3	121-47.8	3.0	1.8	18	141	3.0	0.12	0.5	0.7	B TASSAJARA
	26	20	56	6.7	37-50.0	121-47.7	3.1	1.7	18	142	2.5	0.17	0.7	0.8	C TASSAJARA
	26	20	57	56.8	37-47.6	121-45.8	8.2	1.4	15	153	4.1	0.16	0.8	1.1	C TASSAJARA
	26	21	18	43.7	37-50.3	121-47.6	3.0	1.8	20	79	3.0	0.20	0.7	0.9	B TASSAJARA
	26	22	20	15.2	37-48.9	121-47.6	3.6	1.2	13	72	1.0	0.14	0.6	0.6	A TASSAJARA
	26	22	37	4.1	37-50.4	121-47.3	7.1	2.1	20	82	3.5	0.43	1.4	2.7	B TASSAJARA
	27	0	23	29.4	37-50.7	121-46.6	11.7	2.7	12	97	4.4	0.16	0.9	0.7	B TASSAJARA
	27	0	53	48.9	37-51.5	121-48.5	0.0	1.2	12	156	5.2	0.16	0.7	4.2	C TASSAJARA
	27	0	58	7.7	37-49.7	121-47.6	6.8	1.7	19	75	2.1	0.16	0.6	0.7	B TASSAJARA
	27	1	4	24.9	37-51.3	121-47.9	2.9	1.2	7	170	4.8	0.14	1.3	1.5	C TASSAJARA
	27	1	43	7.3	37-51.3	121-48.3	3.0	1.5	17	80	4.8	0.16	0.5	1.1	B TASSAJARA
	27	1	48	6.1	37-42.1	121-41.1	0.3	1.1	9	199	12.6	0.13	0.9	3.6	C ALTAMONT
	27	2	33	36.2	37-45.0	121-42.8	10.2	5.3	22	117	10.5	0.15	0.6	0.5	B ALTAMONT
	27	2	38	59.3	37-48.3	121-46.6	8.2	1.6	9	135	9.8	0.08	0.6	1.5	B TASSAJARA
	27	2	39	45.8	37-45.7	121-44.0	5.6	1.3	8	201	9.7	0.11	1.3	4.2	C BYRON HOT SPRINGS
	27	2	41	24.9	37-45.3	121-42.7	10.2	1.5	17	126	11.2	0.12	0.5	0.5	B BYRON HOT SPRINGS
	27	2	48	9.1	37-44.8	121-42.3	9.9	1.2	17	121	11.5	0.16	0.6	0.7	B ALTAMONT
	27	2	49	33.0	37-46.5	121-43.8	5.0	1.0	6	166	10.5	0.11	1.2	47.3	C BYRON HOT SPRINGS
	27	3	19	6.9	37-38.7	121-39.1	1.1	1.2	8	203	5.8	0.30	0.7	1.2	C ALTAMONT
	27	3	29	45.1	37-49.1	121-46.8	7.3	1.3	13	147	11.0	0.08	0.4	1.0	B TASSAJARA
	27	3	38	8.3	37-44.9	121-42.0	11.6	1.0	6	173	18.0	0.01	0.1	0.1	B ALTAMONT
	27	3	53	29.9	37-42.2	121-39.4	2.3	2.0	18	166	12.1	0.12	0.5	2.9	C ALTAMONT
	27	4	11	40.3	37-45.3	121-43.7	9.4	1.4	13	147	10.1	0.13	0.7	0.8	B BYRON HOT SPRINGS
	27	4	17	25.7	37-45.7	121-43.5	10.5	1.5	15	108	10.3	0.10	0.5	0.4	B BYRON HOT SPRINGS
	27	4	19	55.2	37-50.1	121-47.8	3.2	1.8	20	77	2.6	0.15	0.6	0.9	B TASSAJARA
	27	4	22	17.4	37-51.3	121-48.4	2.9	1.0	16	80	4.8	0.11	0.4	0.6	A TASSAJARA
	27	4	22	28.7	37-48.2	121-45.4	6.1	2.2	19	80	4.2	0.17	0.7	1.1	B TASSAJARA
	27	4	29	44.6	37-45.0	121-42.3	9.5	1.5	19	120	10.9	0.13	0.5	0.6	B ALTAMONT
	27	4	36	53.4	37-48.4	121-46.3	9.3	1.9	19	80	2.8	0.11	0.4	0.6	A TASSAJARA
	27	4	53	32.4	37-50.3	121-47.5	8.1	1.8	21	80	3.1	0.15	0.5	0.9	A TASSAJARA
	27	5	3	43.0	37-50.1	121-46.9	7.6	1.2	9	147	3.2	0.12	0.8	1.6	B TASSAJARA
	27	5	15	55.4	37-44.9	121-42.7	9.9	2.4	21	117	10.6	0.10	0.4	0.4	B ALTAMONT
	27	6	11	23.4	37-49.9	121-47.3	8.1	1.6	18	78	2.6	0.13	0.6	0.9	A TASSAJARA
	27	7	9	27.3	37-45.6	121-44.1	7.4	1.2	7	111	9.5	0.12	0.9	2.1	B BYRON HOT SPRINGS
	27	7	51	28.4	37-51.0	121-47.9	3.3	2.3	21	82	4.4	0.16	0.5	0.9	B TASSAJARA
	27	8	3	48.4	37-50.0	121-47.6	9.2	1.8	19	77	2.6	0.14	0.5	0.6	A TASSAJARA
	27	9	11	3.0	37-48.5	121-46.6	10.3	1.7	21	73	2.3	0.11	0.4	0.4	A TASSAJARA
	27	9	13	4.4	37-50.1	121-47.4	2.1	1.4	14	144	2.8	0.15	0.7	0.7	B TASSAJARA
	27	9	22	14.8	37-49.4	121-47.3	8.2	1.3	16	75	1.8	0.13	0.5	0.9	A TASSAJARA
	27	9	36	29.2	37-46.1	121-44.3	9.9	1.3	14	107	9.6	0.10	0.4	0.7	B BYRON HOT SPRINGS
	27	10	8	14.6	37-50.0	121-47.1	8.7	1.6	18	146	2.9	0.12	0.5	0.6	B TASSAJARA

LIVERMORE VALLEY EARTHQUAKES JANUARY 24 - FEBRUARY 26, 1980 (CONTINUED)

1980	HR	MN	SEC	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	Q	QUADRANGLE	
JAN	27	10	31	47.0	37-46.6	121-44.7	10.6	1.5	18	95	6.5	0.11	0.4	0.4	B	BYRON HOT SPRINGS
	27	10	43	28.7	37-44.8	121-42.3	10.0	1.4	16	121	11.6	0.12	0.5	0.6	B	ALTAMONT
	27	10	45	37.8	37-49.9	121-47.0	8.7	1.4	18	79	2.8	0.13	0.6	0.7	A	TASSAJARA
	27	10	50	25.5	37-46.3	121-49.1	0.4	1.7	20	123	4.6	0.12	0.2	1.6	B	TASSAJARA
	27	10	52	56.0	37-46.3	121-49.0	0.4	1.0	6	125	4.6	0.19	1.8	13.2	C	TASSAJARA
	27	10	55	2.6	37-46.3	121-49.3	0.0	2.0	24	75	4.7	0.12	0.3	0.4	A	TASSAJARA
	27	10	58	1.5	37-50.3	121-47.8	8.1	3.4	21	79	3.1	0.16	0.5	1.0	B	TASSAJARA
	27	11	0	2.5	37-49.7	121-47.3	8.0	1.5	16	144	2.3	0.13	0.6	0.9	B	TASSAJARA
	27	11	11	4.1	37-50.0	121-47.4	7.5	1.3	15	89	2.7	0.14	0.7	1.3	A	TASSAJARA
	27	11	11	42.6	37-46.4	121-49.0	0.6	1.1	12	76	4.4	0.13	0.4	3.0	B	TASSAJARA
	27	11	13	56.9	37-46.2	121-49.7	0.4	1.9	22	74	4.5	0.15	0.4	2.8	B	TASSAJARA
	27	11	18	24.8	37-39.2	121-38.6	4.8	1.5	12	190	6.5	0.20	1.8	2.0	C	ALTAMONT
	27	11	24	21.8	37-46.3	121-49.5	0.0	2.2	25	74	4.7	0.11	0.3	0.3	A	TASSAJARA
	27	11	30	48.1	37-46.4	121-49.6	0.9	1.3	15	74	4.7	0.17	0.5	4.4	B	TASSAJARA
	27	11	47	37.5	37-46.3	121-49.8	0.3	1.7	23	73	4.6	0.17	0.4	2.9	B	TASSAJARA
	27	12	39	15.2	37-46.0	121-44.6	8.9	1.6	16	105	7.2	0.11	0.5	0.5	B	BYRON HOT SPRINGS
27	12	46	34.8	37-49.5	121-47.2	7.5	1.2	14	76	2.1	0.15	0.7	1.1	B	TASSAJARA	
27	13	0	3.8	37-48.4	121-46.0	9.8	2.3	21	75	3.1	0.12	0.4	0.4	A	TASSAJARA	
27	13	11	47.6	37-50.2	121-47.9	3.7	2.3	20	77	2.8	0.17	0.6	0.8	B	TASSAJARA	
27	13	12	23.0	37-50.7	121-48.6	1.0	1.8	7	131	11.3	0.06	0.4	0.8	B	TASSAJARA	
27	13	38	8.7	37-44.1	121-41.8	0.1	1.7	16	161	12.2	0.13	0.5	3.0	C	ALTAMONT	
27	13	42	20.2	37-50.2	121-47.2	6.3	1.2	17	145	3.1	0.17	0.8	1.2	C	TASSAJARA	
27	14	0	53.8	37-45.0	121-42.4	10.0	1.4	18	120	11.4	0.14	0.6	0.6	B	ALTAMONT	
27	14	50	1.8	37-46.8	121-39.4	5.0	1.2	8	164	6.7	0.28	2.5	9.2	C	BYRON HOT SPRINGS	
27	15	33	50.3	37-50.2	121-48.5	9.2	2.3	19	74	2.9	0.12	0.5	0.5	A	TASSAJARA	
27	16	58	9.4	37-50.5	121-47.4	3.7	0.9	11	187	3.7	0.11	0.8	0.8	C	TASSAJARA	
27	17	0	55.9	37-49.7	121-47.9	6.5	2.1	20	74	1.9	0.13	0.4	0.7	A	TASSAJARA	
27	17	11	10.4	37-45.4	121-46.1	7.1	1.6	15	93	6.7	0.11	0.5	0.9	B	TASSAJARA	
27	18	13	1.8	37-49.8	121-47.6	6.6	1.6	16	76	2.2	0.18	0.7	0.9	B	TASSAJARA	
27	18	51	14.1	37-50.0	121-48.4	7.9	1.1	13	136	2.4	0.10	0.5	0.8	B	TASSAJARA	
27	20	5	22.2	37-51.4	121-48.7	2.5	1.6	16	79	5.1	0.11	0.4	0.7	B	TASSAJARA	
27	20	57	47.8	37-50.1	121-48.3	9.0	1.1	12	137	2.6	0.11	0.6	0.6	B	TASSAJARA	
27	22	33	17.2	37-49.3	121-47.3	10.9	3.0	13	84	1.7	0.16	0.8	0.6	B	TASSAJARA	
27	22	35	58.4	37-49.7	121-48.0	10.1	1.7	18	74	1.9	0.10	0.4	0.4	A	TASSAJARA	
27	22	53	5.9	37-49.6	121-47.6	10.0	2.1	20	75	1.9	0.14	0.5	0.5	A	TASSAJARA	
28	1	19	5.9	37-51.2	121-47.3	10.3	1.8	16	87	4.9	0.13	0.7	0.7	A	TASSAJARA	
28	2	0	38.9	37-50.4	121-48.3	3.4	1.4	11	76	3.3	0.16	0.8	1.2	B	TASSAJARA	
28	3	10	7.8	37-50.3	121-47.7	6.1	2.0	19	79	3.1	0.21	0.7	1.4	B	TASSAJARA	
28	3	10	41.4	37-50.4	121-47.2	5.9	1.4	16	146	3.6	0.17	0.8	1.3	C	TASSAJARA	
28	4	34	38.0	37-50.4	121-48.4	0.8	1.4	7	100	11.8	0.13	0.8	7.1	C	TASSAJARA	
28	5	48	49.4	37-50.9	121-48.0	3.6	1.3	13	81	4.1	0.19	0.8	1.2	B	TASSAJARA	
28	5	51	10.7	37-48.9	121-47.8	8.8	1.8	15	71	0.6	0.13	0.6	0.7	A	TASSAJARA	
28	8	27	45.0	37-50.8	121-48.2	3.1	1.8	20	79	3.9	0.19	0.6	1.1	B	TASSAJARA	
28	8	28	13.3	37-50.7	121-48.1	3.3	2.0	18	79	3.8	0.61	2.0	3.3	C	TASSAJARA	
28	8	29	13.3	37-50.5	121-47.3	4.1	1.8	12	150	3.5	0.18	1.0	1.0	C	TASSAJARA	

LIVERMORE VALLEY EARTHQUAKES JANUARY 24 - FEBRUARY 26, 1980 (CONTINUED)

1930	HR	MIN	SEC	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	Q	QUADRANGLE
JAN	28	8	30	41.1	37-50.8	121-48.3	2.8	1.2	12 79	4.0	0.19	0.8	1.1	B	TASSAJARA
	28	8	32	41.5	37-48.8	121-46.6	9.8	1.6	17 76	2.3	0.12	0.5	0.5	A	TASSAJARA
	28	8	52	43.1	37-50.7	121-48.2	0.7	1.2	10 87	3.7	0.15	0.7	6.9	B	TASSAJARA
	28	8	53	5.5	37-50.7	121-49.8	3.3	1.2	4 201	4.5	0.00			C	TASSAJARA
	28	10	35	27.3	37-51.2	121-48.6	2.5	1.3	11 79	4.8	0.13	0.5	0.7	A	TASSAJARA
	28	12	54	11.1	37-37.9	121-37.9	7.7	1.4	11 187	4.2	0.12	1.1	1.5	C	ALTAMONT
	28	13	16	27.7	37-51.8	121-49.0	1.3	1.6	15 78	5.9	0.17	0.6	1.0	B	TASSAJARA
	28	13	53	30.6	37-51.3	121-48.5	3.0	1.8	17 80	4.9	0.17	0.6	1.3	B	TASSAJARA
	28	13	56	29.0	37-37.9	121-37.8	7.7	1.6	13 151	4.2	0.12	0.7	1.0	B	ALTAMONT
	28	14	30	27.6	37-49.7	121-48.1	8.5	1.8	14 73	1.8	0.13	0.6	1.0	A	TASSAJARA
	28	17	11	45.9	37-49.1	121-46.3	3.3	1.1	13 151	2.8	0.14	0.7	0.8	B	TASSAJARA
	28	17	22	17.0	37-49.0	121-46.1	4.6	0.9	10 152	3.0	0.13	0.8	0.8	B	TASSAJARA
	28	18	4	2.8	37-51.2	121-49.1	2.1	2.0	18 93	4.9	0.16	0.5	0.7	B	TASSAJARA
	28	21	45	4.4	37-51.8	121-49.2	1.0	2.0	18 77	5.9	0.20	0.6	4.3	B	TASSAJARA
	28	22	59	49.0	37-51.2	121-47.7	1.6	1.2	12 142	4.6	0.09	0.5	0.6	B	TASSAJARA
	28	23	16	49.7	37-50.4	121-47.4	2.9	1.2	11 144	3.4	0.13	0.7	0.7	B	TASSAJARA
	28	23	32	51.8	37-48.1	121-45.8	6.1	1.1	14 153	3.6	0.13	0.6	0.9	B	TASSAJARA
	29	1	14	37.1	37-50.4	121-47.6	2.9	1.4	9 142	3.3	0.15	1.0	0.9	B	TASSAJARA
	29	1	46	4.2	37-47.3	121-44.8	9.2	3.3	20 152	5.6	0.12	0.5	0.6	B	BYRON HOT SPRINGS
	29	2	5	35.8	37-47.4	121-44.9	6.0	1.5	17 151	5.3	0.14	0.6	1.0	B	BYRON HOT SPRINGS
	29	2	16	6.2	37-50.6	121-46.9	3.3	1.7	14 148	4.0	0.15	0.9	0.9	C	TASSAJARA
	29	2	31	40.7	37-49.8	121-47.6	6.6	1.3	12 142	2.2	0.17	0.9	1.0	C	TASSAJARA
	29	2	51	16.4	37-50.4	121-47.3	2.9	1.7	16 144	3.4	0.15	0.7	0.7	C	TASSAJARA
	29	3	8	24.7	37-50.4	121-47.1	3.1	2.1	17 147	3.6	0.13	0.6	0.7	B	TASSAJARA
	29	3	19	4.2	37-50.5	121-47.2	2.9	2.1	18 140	3.7	0.12	0.5	0.5	B	TASSAJARA
	29	3	23	7.2	37-50.3	121-47.7	3.1	2.0	18 169	3.0	0.13	0.6	0.6	B	TASSAJARA
	29	4	26	16.9	37-51.1	121-47.2	3.8	1.6	14 140	4.5	0.13	0.6	0.7	B	TASSAJARA
	29	4	28	33.6	37-50.5	121-47.1	3.1	2.0	14 146	3.7	0.11	0.6	0.7	B	TASSAJARA
	29	5	17	5.9	37-50.1	121-47.1	3.0	1.2	14 146	3.0	0.15	0.6	0.9	B	TASSAJARA
	29	5	25	19.3	37-50.5	121-47.4	2.9	2.0	17 144	3.5	0.10	0.5	0.5	B	TASSAJARA
	29	5	44	41.7	37-39.9	121-38.3	2.5	2.7	16 166	7.8	0.15	0.7	1.0	B	ALTAMONT
	29	8	10	22.8	37-51.3	121-47.9	3.1	1.1	16 140	4.8	0.13	0.6	1.0	B	TASSAJARA
	29	8	12	12.9	37-50.3	121-47.4	3.1	1.7	17 144	3.2	0.10	0.5	0.6	B	TASSAJARA
	29	10	1	58.7	37-51.0	121-48.0	3.9	1.8	17 139	4.3	0.10	0.5	0.5	B	TASSAJARA
	29	12	26	51.9	37-44.2	121-42.5	0.3	1.2	13 168	11.3	0.12	0.6	3.2	C	ALTAMONT
	29	14	34	50.6	37-50.1	121-47.1	6.3	1.8	17 146	3.0	0.13	0.6	0.8	B	TASSAJARA
	29	16	37	34.7	37-50.1	121-46.8	3.2	2.6	18 142	3.3	0.24	0.9	1.2	C	TASSAJARA
	29	19	53	19.1	37-51.4	121-48.3	3.3	1.7	17 137	5.0	0.14	0.6	0.9	B	TASSAJARA
	29	21	48	39.6	37-50.3	121-47.3	3.0	1.9	11 144	3.3	0.14	0.7	1.0	B	TASSAJARA
	30	1	57	47.7	37-48.0	121-45.9	6.9	1.8	9 208	10.0	0.11	1.3	1.3	C	TASSAJARA
	30	4	0	49.6	37-51.1	121-46.9	12.1	2.0	8 192	12.8	0.11	1.2	0.9	C	TASSAJARA
	30	8	38	10.1	37-48.7	121-46.6	7.4	1.2	18 149	2.3	0.12	0.5	0.7	B	TASSAJARA
	30	9	11	34.7	37-48.9	121-46.8	8.4	1.6	20 142	2.0	0.12	0.5	0.6	B	TASSAJARA
	30	10	58	48.5	37-52.2	121-48.9	2.3	1.4	10 131	6.7	0.14	0.7	0.9	B	TASSAJARA
	30	11	17	35.8	37-51.3	121-47.8	3.8	1.3	10 141	4.8	0.14	0.8	1.0	B	TASSAJARA

LIVERMORE VALLEY EARTHQUAKES JANUARY 24 - FEBRUARY 26, 1980 (CONTINUED)

1930	HR	MN	SEC	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	Q	QUADRANGLE
JAN	30	14	35	29.3	37-49.5	121-47.3	10.1	1.3	16	144	2.0	0.10	0.5	0.4	B TASSAJARA
	30	14	38	31.3	37-51.3	121-48.0	3.3	1.7	18	134	4.9	0.14	0.5	0.9	B TASSAJARA
	30	17	19	59.1	37-39.3	121-38.3	6.1	1.4	11	167	6.7	0.19	1.5	2.8	C ALTAMONT
	30	21	22	0.8	37-50.6	121-47.1	5.6	1.2	14	146	3.9	0.20	1.0	1.8	C TASSAJARA
	31	0	47	15.2	37-50.4	121-48.3	8.7	1.8	18	137	3.1	0.15	0.6	0.7	B TASSAJARA
	31	2	59	17.4	37-48.5	121-48.6	0.4	1.4	8	92	0.7	0.38	2.3	1.9	C TASSAJARA
	31	5	11	54.1	37-50.4	121-47.7	3.1	1.2	11	141	3.2	0.18	1.0	1.2	C TASSAJARA
	31	8	16	45.4	37-46.5	121-44.0	8.9	0.8	7	163	7.3	0.07	0.9	1.1	B BYRON HOT SPRINGS
	31	13	43	55.8	37-50.1	121-47.3	3.0	1.5	18	144	3.0	0.15	0.6	0.8	C TASSAJARA
	31	13	46	40.8	37-50.2	121-48.0	2.9	1.5	15	139	2.8	0.15	0.6	0.7	C TASSAJARA
	31	13	49	16.4	37-50.4	121-47.7	4.5	0.9	7	142	3.2	0.09	0.7	0.9	B TASSAJARA
	31	15	53	33.8	37-47.6	121-46.3	9.4	1.5	13	144	3.4	0.08	0.4	0.5	B TASSAJARA
	31	18	2	3.6	37-48.5	121-46.2	9.8	2.1	16	146	3.0	0.07	0.3	0.3	B TASSAJARA
	31	23	28	56.3	37-50.5	121-46.4	2.9	1.7	11	152	4.3	0.10	0.6	0.6	B TASSAJARA
FEB	1	0	9	58.3	37-50.3	121-46.7	7.2	0.2	10	177	3.6	0.16	1.5	1.6	C TASSAJARA
	1	0	10	1.5	37-50.2	121-46.7	8.1	1.8	10	149	3.4	0.15	1.3	1.4	C TASSAJARA
	1	0	11	28.0	37-50.3	121-45.9	8.6	1.0	11	217	5.1	0.09	0.9	0.7	C TASSAJARA
	1	0	11	30.7	37-51.3	121-51.9	12.6	1.2	4	135	7.3	0.01			C TASSAJARA
	1	10	19	49.4	37-50.1	121-45.9	2.8	1.1	8	206	4.1	0.25	2.4	1.8	C TASSAJARA
	1	10	30	52.4	37-50.4	121-47.3	3.0	1.9	18	145	3.5	0.16	0.7	0.7	C TASSAJARA
	1	10	31	16.7	37-50.5	121-47.6	2.6	2.1	15	170	3.4	0.14	0.7	0.8	B TASSAJARA
	1	10	47	6.3	37-53.4	121-49.2	11.3	1.1	16	125	7.9	0.08	0.4	0.3	B ANTIOCH SOUTH
	1	11	26	48.1	37-50.4	121-47.2	3.2	2.2	19	140	3.4	0.16	0.6	0.8	C TASSAJARA
	1	13	44	31.3	37-49.6	121-47.1	6.2	-0.1	14	146	2.3	0.16	0.8	1.0	C TASSAJARA
	1	13	44	33.2	37-50.3	121-52.3	16.7	1.1	4	132	8.5	0.07			C TASSAJARA
	1	13	54	0.0	37-45.5	121-43.2	8.4	1.7	15	167	9.4	0.07	0.4	0.5	B BYRON HOT SPRINGS
	1	21	5	2.5	37-47.5	121-45.2	9.1	2.3	15	150	4.9	0.09	0.4	0.6	B TASSAJARA
	1	23	59	57.8	37-49.9	121-47.2	7.1	1.4	12	145	2.7	0.12	0.7	0.9	B TASSAJARA
	2	5	54	6.9	37-52.1	121-48.8	0.3	2.1	17	132	6.4	0.35	1.3	7.9	C TASSAJARA
	2	9	28	25.8	37-50.2	121-48.4	8.5	1.2	9	158	2.8	0.09	0.7	0.7	B TASSAJARA
	2	13	16	37.2	37-40.5	121-40.7	0.5	1.6	8	193	9.6	0.18	1.9	9.6	D ALTAMONT
	2	16	40	22.6	37-50.3	121-48.7	7.4	1.2	12	134	3.1	0.14	0.8	1.2	B TASSAJARA
	2	20	49	41.9	37-51.1	121-47.8	3.3	0.9	10	141	4.4	0.10	0.6	0.8	B TASSAJARA
	3	1	39	52.9	37-51.6	121-47.9	2.8	1.3	12	165	5.4	0.17	1.1	1.1	C TASSAJARA
	3	1	44	0.2	37-51.4	121-47.7	3.0	1.4	16	142	5.2	0.15	0.6	1.1	B TASSAJARA
	3	4	3	39.6	37-41.7	121-38.8	3.0	1.5	7	194	11.1	0.19	1.8	3.1	C ALTAMONT
	3	8	27	46.0	37-41.7	121-39.1	2.2	1.0	7	169	11.1	0.15	1.3	1.9	C ALTAMONT
	3	12	29	28.0	37-38.1	121-38.9	9.5	1.3	8	180	4.6	0.08	0.8	1.0	B ALTAMONT
	3	15	34	31.9	37-51.4	121-48.0	3.4	1.3	10	139	5.0	0.12	0.7	1.1	B TASSAJARA
	3	19	7	40.1	37-43.7	121-42.7	0.3	1.7	7	165	11.0	0.02	0.1	0.7	B ALTAMONT
	3	19	36	50.1	37-50.2	121-48.8	8.5	1.4	10	146	2.9	0.09	0.6	0.7	B TASSAJARA
	3	21	48	25.1	37-50.2	121-48.5	9.0	1.7	12	156	2.9	0.10	0.6	0.5	B TASSAJARA
	4	23	19	17.2	37-50.3	121-47.3	6.4	1.8	16	144	3.2	0.17	0.7	1.1	C TASSAJARA
	4	23	22	26.4	37-50.6	121-47.0	6.5	2.1	15	157	3.9	0.15	0.9	1.1	C TASSAJARA
	5	0	52	38.4	37-50.7	121-47.0	7.6	1.5	11	147	4.0	0.10	0.8	0.7	B TASSAJARA

LIVERMORE VALLEY EARTHQUAKES JANUARY 24 - FEBRUARY 26, 1980 (CONTINUED)

1930	HR	MIN	SEC	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	Q	QUADRANGLE	
FEB	5	10	35	26.7	37-50.1	121-47.8	2.9	1.8	14	140	2.8	0.11	0.6	0.5	B	TASSAJARA
	5	13	47	36.7	37-45.6	121-43.2	5.4	1.4	12	167	9.2	0.07	0.4	1.7	B	BYRON HOT SPRINGS
	6	1	9	8.0	37-46.0	121-45.9	0.2	2.2	15	148	7.4	0.17	0.7	5.8	C	TASSAJARA
	6	5	28	3.8	37-48.9	121-46.8	9.2	1.3	10	147	2.1	0.07	0.5	0.5	B	TASSAJARA
	6	6	55	13.1	37-51.0	121-48.3	9.9	1.2	7	162	4.4	0.07	0.9	0.8	B	TASSAJARA
	6	17	11	30.3	37-50.8	121-47.5	4.3	2.1	6	186	12.4	0.04	0.4	0.6	C	TASSAJARA
	7	2	17	13.9	37-48.9	121-47.0	4.2	1.5	6	200	10.5	0.02	0.2	0.5	C	TASSAJARA
	7	2	28	6.6	37-48.3	121-46.4	2.8	2.0	7	209	10.0	0.03	0.3	1.6	C	TASSAJARA
	7	6	47	25.0	37-47.7	121-45.4	8.5	1.9	15	155	4.3	0.09	0.5	0.6	B	TASSAJARA
	8	2	59	54.3	37-38.3	121-38.9	5.6	1.5	16	160	4.9	0.17	0.9	1.4	C	ALTAMONT
	8	3	20	14.1	37-45.2	121-42.8	8.3	1.3	9	169	11.1	0.04	0.3	0.4	B	BYRON HOT SPRINGS
	8	3	23	22.4	37-40.5	121-40.1	2.5	2.1	14	160	9.4	0.17	1.0	1.4	C	ALTAMONT
	8	3	43	34.7	37-39.2	121-42.9	0.4	1.6	5	158	9.5	0.02	0.1	1.1	C	ALTAMONT
	8	8	30	55.6	37-49.8	121-47.6	1.5	1.1	7	189	11.7	0.05	0.4	0.6	C	TASSAJARA
	8	11	44	0.1	37-41.1	121-38.3	7.8	1.8	4	246	10.0	0.16			C	ALTAMONT
	8	22	40	26.2	37-51.2	121-47.7	4.0	2.0	10	155	4.7	0.17	1.3	1.2	C	TASSAJARA
	9	0	5	53.0	37-45.8	121-43.8	8.0	1.9	20	155	8.4	0.09	0.4	0.7	B	BYRON HOT SPRINGS
	9	8	30	55.7	37-49.2	121-47.7	7.4	1.2	8	152	1.2	0.09	0.7	0.7	B	TASSAJARA
	9	10	22	1.4	37-50.3	121-48.9	8.0	1.6	19	132	3.2	0.12	0.5	0.8	B	TASSAJARA
	9	11	7	1.8	37-50.3	121-47.8	7.0	1.3	16	141	3.1	0.14	0.6	0.9	B	TASSAJARA
	9	11	58	52.8	37-49.6	121-47.2	6.0	1.9	19	145	2.2	0.17	0.7	1.0	C	TASSAJARA
	9	18	34	54.2	37-35.7	121-35.8	4.2	1.6	15	168	3.6	0.16	0.9	0.8	C	CEDAR MTN
	10	1	30	28.7	37-48.7	121-48.3	0.3	2.0	14	136	9.5	0.26	0.4	2.6	C	TASSAJARA
	10	4	45	43.6	37-46.0	121-43.5	8.8	1.7	17	157	8.3	0.13	0.6	0.7	B	BYRON HOT SPRINGS
	10	21	20	20.2	37-47.6	121-45.4	10.0	1.2	10	155	4.4	0.09	0.7	0.6	B	TASSAJARA
	11	0	4	22.0	37-49.6	121-48.0	3.6	1.0	5	184	11.2	0.03	0.4	0.8	C	TASSAJARA
	11	7	43	59.5	37-54.9	121-49.0	8.5	1.6	15	120	7.8	0.11	0.5	0.6	B	ANTIOCH SOUTH
	11	7	53	41.7	37-54.9	121-48.5	8.8	1.0	13	125	8.0	0.09	0.5	0.6	B	ANTIOCH SOUTH
	11	8	7	27.1	37-54.9	121-48.7	8.9	1.7	16	124	8.1	0.17	0.8	0.9	B	ANTIOCH SOUTH
	11	10	56	57.2	37-47.7	121-45.3	6.5	1.6	17	156	4.5	0.11	0.5	0.7	B	TASSAJARA
	12	0	4	21.8	37-48.8	121-47.6	9.6	1.3	5	259	0.9	0.02	1.0	0.6	C	TASSAJARA
	12	6	15	50.5	37-49.4	121-47.0	6.4	1.3	15	146	2.2	0.13	0.6	0.8	B	TASSAJARA
	12	18	6	2.5	37-46.9	121-45.0	2.1	1.0	9	235	5.6	0.33	3.6	2.5	D	TASSAJARA
	12	20	57	44.4	37-51.6	121-48.4	2.9	1.4	15	135	5.4	0.11	0.4	0.7	B	TASSAJARA
	13	0	29	56.3	37-40.3	121-37.8	1.8	2.8	20	169	8.6	0.20	1.0	1.6	C	ALTAMONT
	13	1	7	0.9	37-49.3	121-47.3	8.2	2.0	20	140	2.4	0.13	0.5	0.7	B	TASSAJARA
	13	1	27	38.2	37-45.6	121-43.1	9.8	2.0	18	159	9.4	0.10	0.5	0.5	B	BYRON HOT SPRINGS
	13	2	13	37.4	37-53.5	121-47.3	9.9	1.2	14	144	9.1	0.09	0.5	0.6	B	ANTIOCH SOUTH
	13	7	22	26.0	37-50.4	121-48.1	9.1	2.0	20	134	3.3	0.11	0.4	0.4	B	TASSAJARA
	13	19	42	55.3	37-50.0	121-46.9	7.7	1.3	9	147	3.0	0.12	0.8	1.1	B	TASSAJARA
	14	19	12	57.8	37-48.6	121-48.6	0.4	1.5	11	69	0.6	0.25	1.0	1.1	B	TASSAJARA
	14	23	27	9.3	37-35.7	121-43.6	0.4	1.0	6	123	7.9	0.07	0.2	2.7	B	MENDENHALL SPRINGS
	15	16	48	1.1	37-49.7	121-47.2	7.3	2.2	18	145	2.4	0.13	0.6	0.8	B	TASSAJARA
	16	5	24	20.3	37-39.8	121-40.1	2.1	1.5	10	174	8.1	0.19	1.9	3.1	C	ALTAMONT
	16	6	31	41.5	37-36.3	121-39.7	4.5	1.5	9	148	2.5	0.15	1.2	1.2	C	MENDENHALL SPRINGS

LIVERMORE VALLEY EARTHQUAKES JANUARY 24 - FEBRUARY 26, 1980 (CONTINUED)

1980	HR	MN	SEC	LAT N	LONG W	DEPTH	MAG	NO	GAP	DMIN	RMS	ERH	ERZ	Q	QUADRANGLE
FEB	16	21	37	7.4	37-50.0	121-47.3	6.7	1.5	12 144	2.7	0.10	0.6	0.7	B	TASSAJARA
	17	2	12	35.1	37-35.3	121-41.1	8.1	1.5	7 119	4.3	0.22	5.0	8.4	C	MENDENHALL SPRINGS
	18	11	53	10.3	37-49.7	121-47.0	4.1	1.9	18 141	11.8	0.12	0.5	0.8	B	TASSAJARA
	18	12	46	31.7	37-41.1	121-41.8	0.0	1.5	10 162	11.4	0.10	0.5	3.2	C	ALTAMONT
	18	13	20	1.2	37-54.1	121-53.1	15.2	1.4	4 114	2.1	0.09			C	CLAYTON
	19	17	30	59.2	37-42.0	121-40.1	6.0	1.1	9 181	12.1	0.13	1.1	3.7	C	ALTAMONT
	19	20	20	58.6	37-46.9	121-44.9	1.0	2.4	17 158	9.6	0.11	0.4	0.8	B	BYRON HOT SPRINGS
	20	16	1	29.8	37-49.1	121-47.0	11.0	1.7	15 155	1.8	0.08	0.4	0.3	B	TASSAJARA
	21	6	55	30.3	37-39.3	121-40.4	7.1	2.6	20 98	2.6	0.09	0.4	0.5	B	ALTAMONT
	21	18	57	29.8	37-39.5	121-41.0	6.1	3.6	19 106	3.5	0.10	0.5	0.6	B	ALTAMONT
	21	19	2	2.6	37-39.4	121-40.7	6.0	1.2	14 102	3.0	0.14	1.0	1.8	B	ALTAMONT
	21	19	2	34.6	37-39.5	121-40.5	6.2	1.2	12 129	2.8	0.18	1.7	2.5	B	ALTAMONT
	21	19	3	47.3	37-39.3	121-40.2	7.2	1.4	14 96	2.2	0.14	1.0	1.5	B	ALTAMONT
	21	19	49	46.3	37-39.4	121-40.9	6.1	2.9	21 100	3.4	0.11	0.5	0.7	B	ALTAMONT
	21	20	22	45.9	37-39.3	121-41.1	5.5	1.3	12 96	3.6	0.10	0.7	1.5	B	ALTAMONT
	22	3	4	49.8	37-39.4	121-41.1	5.8	1.9	20 120	3.6	0.11	0.7	1.2	B	ALTAMONT
	22	3	45	45.9	37-39.3	121-41.0	6.0	1.9	21 97	3.5	0.07	0.3	0.5	B	ALTAMONT
	22	17	51	31.2	37-46.8	121-44.6	6.5	1.2	12 162	9.8	0.16	1.0	1.7	C	BYRON HOT SPRINGS
	22	22	26	26.9	37-51.0	121-47.3	3.2	2.9	17 145	4.4	0.14	0.6	0.8	B	TASSAJARA
	22	22	35	36.6	37-50.8	121-47.3	3.2	2.1	18 144	4.1	0.13	0.5	0.8	B	TASSAJARA
	22	22	58	8.2	37-50.3	121-47.4	3.3	2.8	19 138	4.1	0.13	0.5	0.7	B	TASSAJARA
	22	23	3	16.0	37-50.9	121-47.3	3.1	1.9	17 144	4.4	0.14	0.6	0.9	B	TASSAJARA
	23	0	8	55.7	37-39.4	121-40.6	5.9	2.4	20 155	16.2	0.12	0.5	0.9	B	ALTAMONT
	23	1	3	6.9	37-50.0	121-46.5	3.3	1.4	13 150	3.4	0.27	1.4	1.6	C	TASSAJARA
	23	2	26	13.2	37-51.0	121-47.6	3.1	1.5	18 143	4.4	0.15	0.6	0.9	C	TASSAJARA
	23	2	59	8.2	37-50.3	121-47.5	3.0	1.5	14 143	3.9	0.17	0.8	0.9	C	TASSAJARA
	23	19	5	55.4	37-39.2	121-42.0	2.5	1.0	8 167	8.6	0.12	2.2	3.8	C	ALTAMONT
	24	7	46	30.4	37-50.3	121-47.0	5.4	1.5	17 147	3.4	0.16	0.7	1.2	C	TASSAJARA
	24	12	55	26.9	37-50.5	121-48.6	7.4	1.3	16 134	3.4	0.12	0.5	0.9	B	TASSAJARA
	24	22	21	21.0	37-39.4	121-40.8	6.1	1.3	11 163	7.8	0.12	0.8	1.7	B	ALTAMONT
	25	18	4	18.4	37-49.0	121-46.2	6.0	1.0	10 152	11.2	0.13	0.8	3.3	C	TASSAJARA
	26	10	20	52.6	37-48.1	121-45.7	11.1	2.1	19 148	3.7	0.09	0.4	0.4	B	TASSAJARA
	26	10	25	36.7	37-48.1	121-45.9	10.7	1.5	18 147	3.5	0.07	0.3	0.3	B	TASSAJARA

TABLE 1. STATION DATA *

40

CODE	LAT N	LONG W	ELV	CORR	DATE **
CAC	37-58.57	121-45.62	74	0.31	
CAI	37-51.68	122-25.77	223	-0.93	
CAL	37-27.07	121-47.95	265	-0.41	
CBR	37-48.97	122- 3.72	610	-0.29	
CBW	37-55.45	122- 6.40	221	-0.32	
CCN	37-47.49	121-56.89	219	0.07	
CCY	37-33.10	122- 5.45	67	-0.67	
CDO	37-43.80	121-50.12	198	0.13	
CDS	37-57.98	122-15.17	109	-0.57	
CDU	38- 1.78	122- 0.05	168	-0.01	
CLC	37-44.28	122- 3.83	312	-0.32	
CMC	37-46.88	122-10.55	90	-0.58	
CMH	37-21.57	121-45.38	518	-0.28	
CMJ	37-31.25	121-52.23	498	-0.26	
CMM	37-27.34	121-29.62	1117	-0.15	
CMO	37-48.68	121-48.15	792	0.00	
CMR	37-35.68	121-38.22	500	-0.32	
CPL	37-38.25	121-57.64	317	-0.30	
CRA	37-46.03	121-56.25	171	-0.06	
CRP	37-54.75	121-54.33	331	-0.45	
CSC	37-17.11	121-46.35	128	0.13	
CSH	37-38.88	122- 2.57	170	-0.40	
CTL	37-39.44	121-38.63	458	-0.07	
JBC	37- 9.62	122- 1.57	660	-0.33	
JMG	37-38.22	122-28.43	201	-0.95	
JSA	37-34.95	122-25.03	207	-0.79	
JSF	37-24.31	122-10.55	143	-0.51	
JSG	37-16.96	122- 3.00	198	-0.02	
JSJ	37-20.03	122- 5.48	122	-0.17	
JWS	37-25.08	122-16.33	280	-0.54	
LVA1	37-50.30	121-38.43	122	0.50	01/24 TO 02/19
LVVR	37-45.67	121-44.10	334	0.05	01/24 TO 02/19
MBF	37-40.71	120-21.80	309	-1.80	
MCH	38- 1.12	120-30.57	475	-1.50	
MCU	37-58.36	120-37.02	336	-1.50	
MNH	38- 8.57	120-48.82	219	-1.50	
MOY	37-54.00	120-34.04	176	-1.50	
MRF	38-14.72	120-31.24	799	-1.10	
MST	37-54.27	120-24.29	366	-1.50	
NHM	38- 9.28	121-48.02	65	0.48	

* LAT AND LONG ARE LATITUDE AND LONGITUDE IN DEGREES AND MINUTES. ELV IS ELEVATION IN METERS. CORR IS THE TIME CORRECTION IN SECONDS.

** THIS COLUMN INDICATES THE OPERATION PERIOD. IF IT IS BLANK THEN THIS STATION HAS BEEN OPERATED CONTINUOUSLY DURING 1980.

Table 2
MAGNITUDES

January 24 - 1900

	M_L	M_E	M_C	m_b	M_S	M_W
BRK	5.5					5.8
NEIS				5.3	5.8	
OES (USGS)		5.9	5.6			5.8

January 25 - 0512

BRK	4.9					
NEIS				4.2		
OES (USGS)		4.3	4.3			

January 27 - 0233

BRK	5.8					5.5
NEIS				5.0	5.0	
OES (USGS)		5.3	5.1			5.4

Table 3

<u>CODA MAGNITUDE ESTIMATES</u>						
STATION	Jan 24 1900	*MAGNITUDE	Jan 25 0512	MAGNITUDE	Jan 27 0233	MAGNITUDE
	DURATION IN SECONDS		DURATION IN SECONDS		DURATION IN SECONDS	
JCB	840	5.7	300	4.5	525	5.2
KFP	660	5.4	180	3.9	405	4.9
KBS	720	5.6	165	3.8	420	4.9
PBW	840	5.7	285	4.4	525	5.2
CDO	825	5.7	330	4.6	525	5.2
BVL	765	5.6	270	4.4	495	5.1
PTY	795	5.7	285	4.4	480	5.1
CAO	795	5.7	255	4.3	510	5.1
CPL	OFF	OFF	375	4.8	600	5.3
LSL	825	5.7	OFF	OFF	OFF	OFF
GBD	660	5.4	225	4.2	432	4.9
PBY	765	5.6	180	3.9	390	4.8
PGH	795	5.7	255	4.3	525	5.2
MRF	780	5.6	300	4.5	585	5.3
OBH	780	5.6	315	4.6	510	5.1
ARW	765	5.6	345	4.7	555	5.2
WCP	810	5.7	300	4.5	660	5.4
WOR	310	5.7	225	4.2	405	4.9
LEH	645	5.4	165	3.8	330	4.6
AVERAGE MAGNITUDE		*5.6		4.3		5.1

*Magnitude results reflect estimate of minimum signal duration due to signal contamination by aftershock.

Table 4

	<u>SOURCE PARAMETERS</u>	
	<u>BRK*</u>	<u>OES+</u>
<u>January 24 - 1900</u>		
M_0 ($\times 10^{24}$ dyne-cm)	6	6
a (rupture radius)		2.0 km
T (effective stress)		100-200 bars
<u>January 27 - 0233</u>		
M_0 ($\times 10^{24}$ dyne-cm)	2	1.5
a		2.0 km
T		150-200 bars

* from Bolt et al. (1980)

+ from J. Boatwright, pers. comm.

Figure Captions

- Figure 1. Index map of the San Francisco Bay region showing the major faults and seismograph stations in the USGS central California network. The shaded area is the Livermore Valley area (Fig. 2) with the two largest earthquakes of this sequence indicated by the ☒ . Permanent seismograph stations are indicated by a Δ , and temporary station by a $\blacktriangle$.
- Figure 2. Map of the Livermore Valley area showing the U.S.G.S. seismograph stations, and the faults mapped by Herd and their relationship to the main shock and largest aftershock.
- Figure 3. Epicenter maps showing all aftershock location (a) and only those events with A and B quality solutions (b) .
- Figure 4. a: Cross-sectional plot of A and B quality solution hypocenters along line A - A' .
b: Transverse view of the cross-sectional plot along A - A' as viewed from A' .
See Figure 3 for position of A and A' .
- Figure 5. First P-motion plot showing nodal plane solutions for the mainshock (a) and largest aftershock (b) . The diagrams are equal-area, lower hemisphere projections. C and + are compressions and D and - are dilations (+ and - are less distinct first motions than C and D) . X indicates a C and D at the same location.

Figure 6. Compressional (P) and tensional (T) axes derived from first-motion data. January 24 and January 27 refer to the mainshock and largest aftershock, respectively.

Figure 7. First P-motion plot for the foreshock showing the ambiguity in dip of the nodal planes. The preferred nodal plane solution is indicated by the solid lines.

Figure 8. Cumulative number of earthquakes vs. magnitude for events of magnitude 1.6 and larger.

Figure 9. Aftershock decay with time of events of magnitude 1.6 and larger.

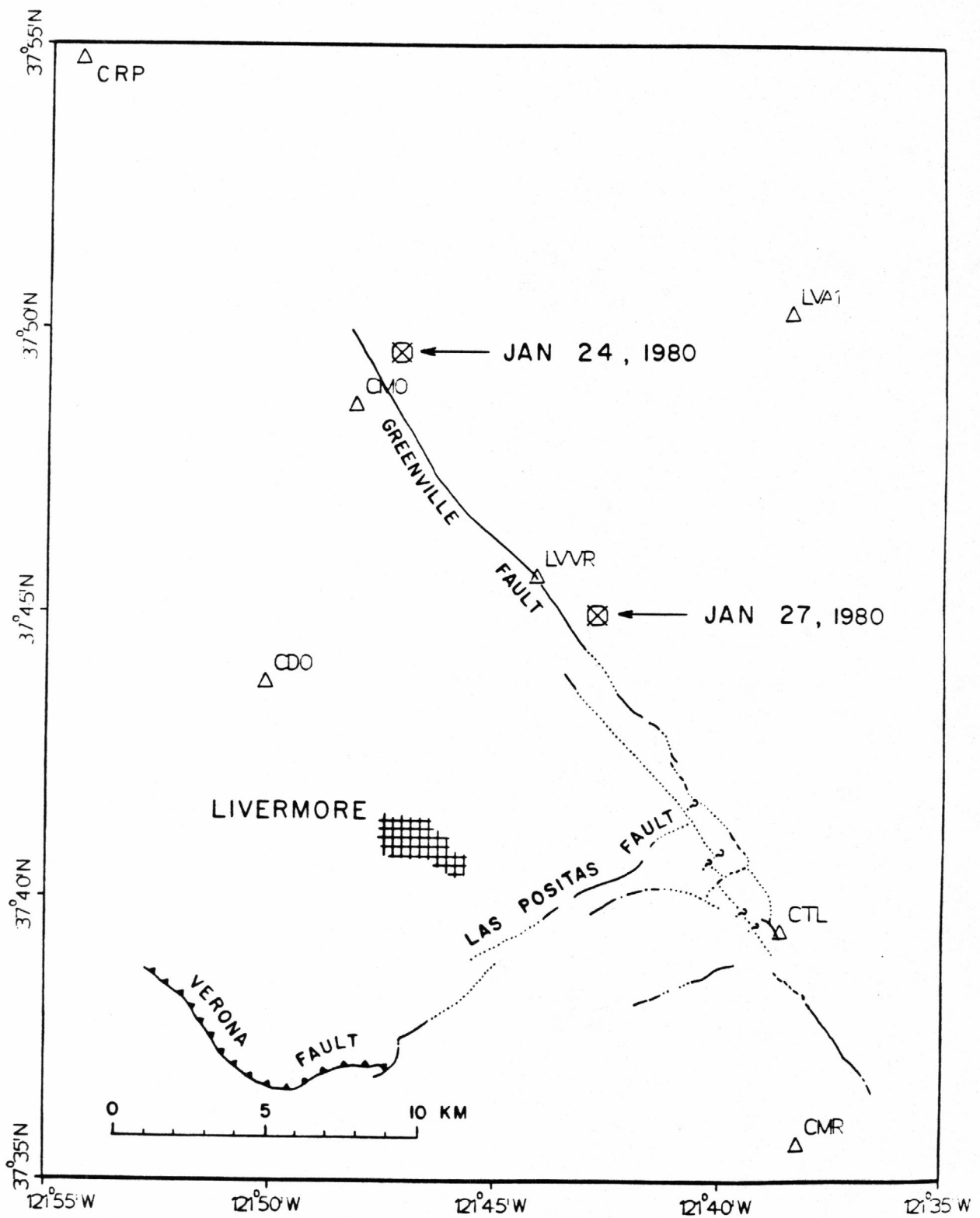


Figure 2

LIVERMORE VALLEY EARTHQUAKES

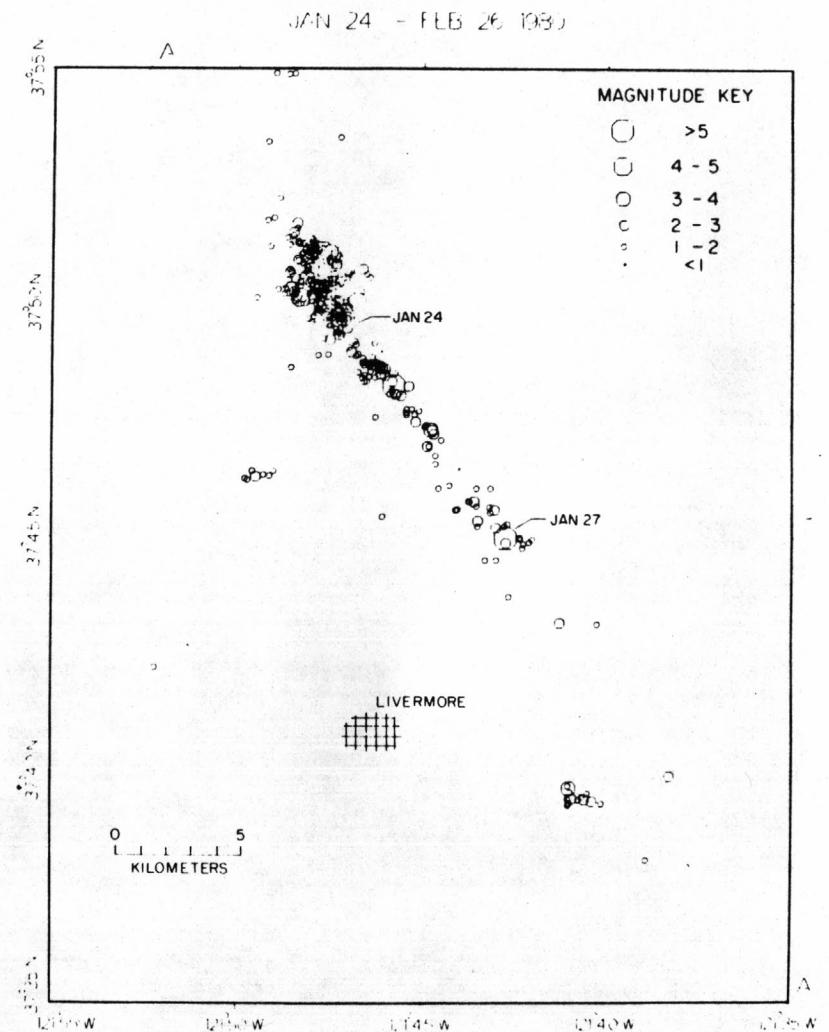
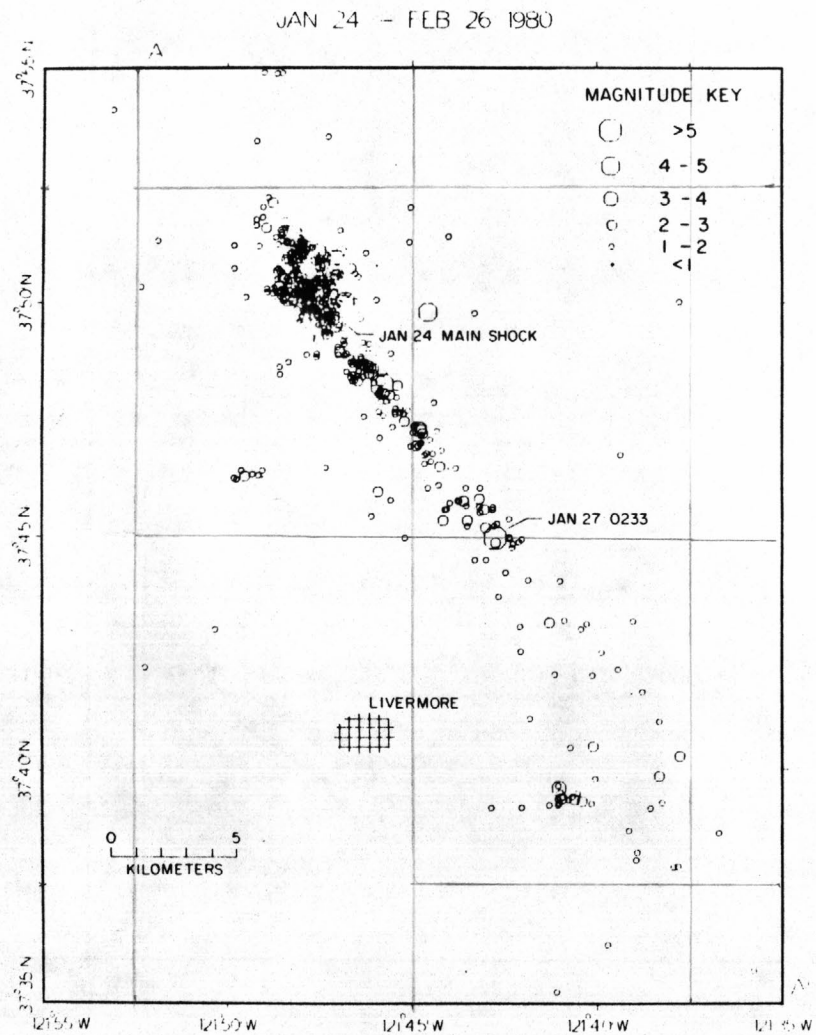


Figure 3

LIVERMORE VALLEY EARTHQUAKES

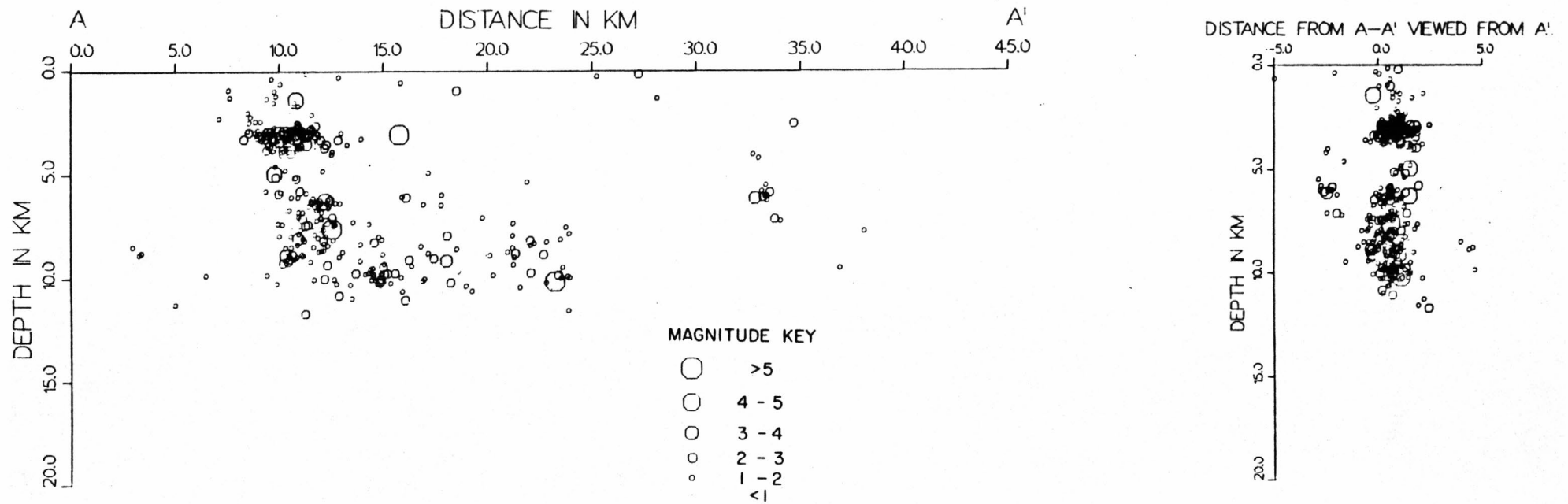
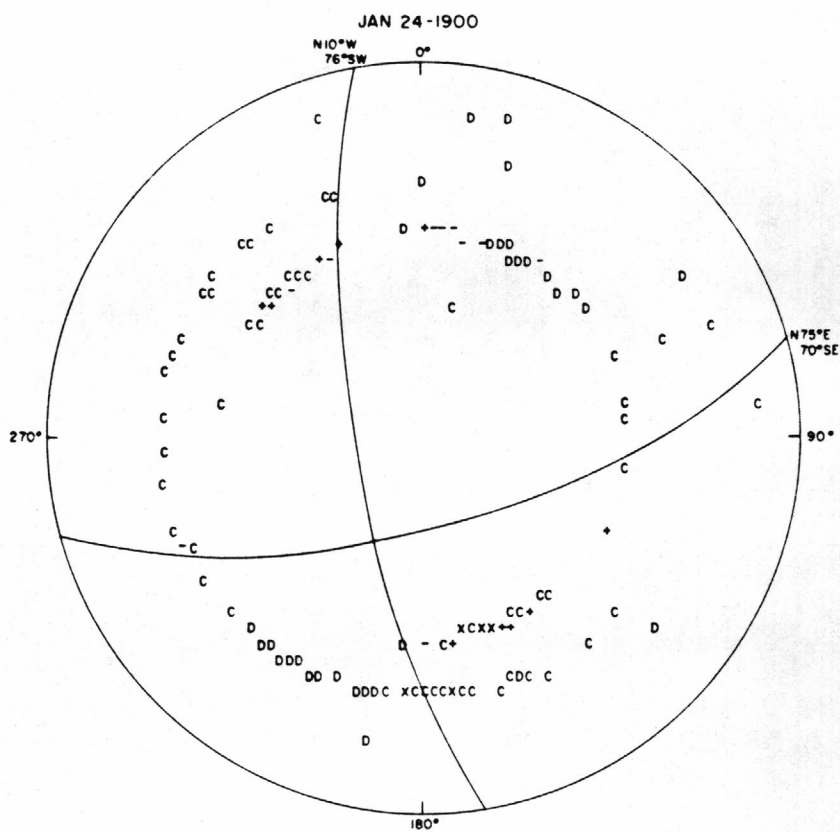
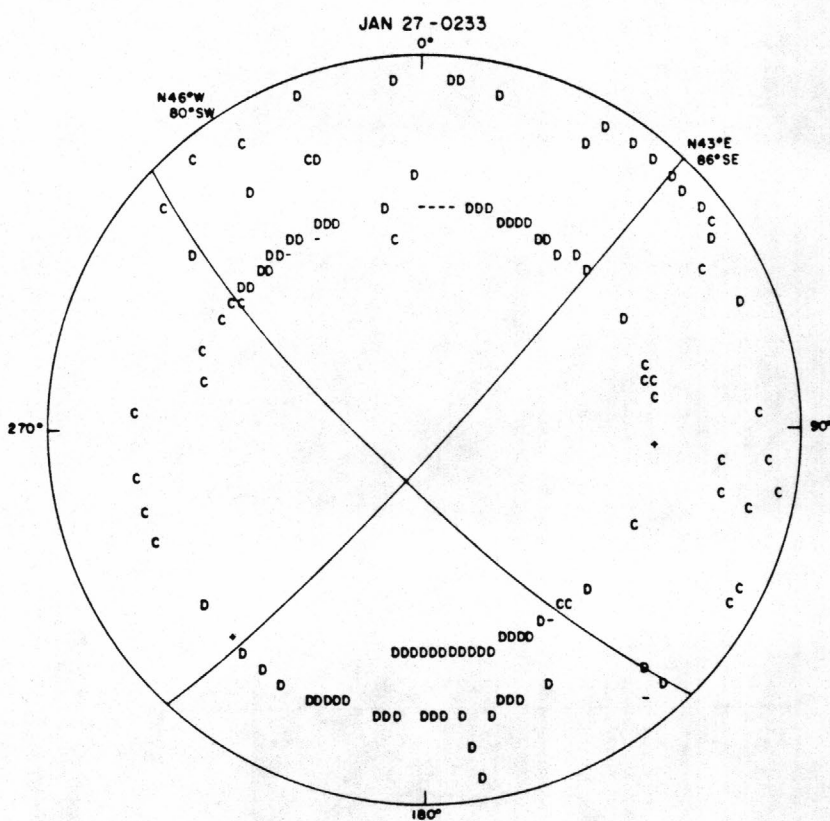


Figure 4



a



b

Figure 5

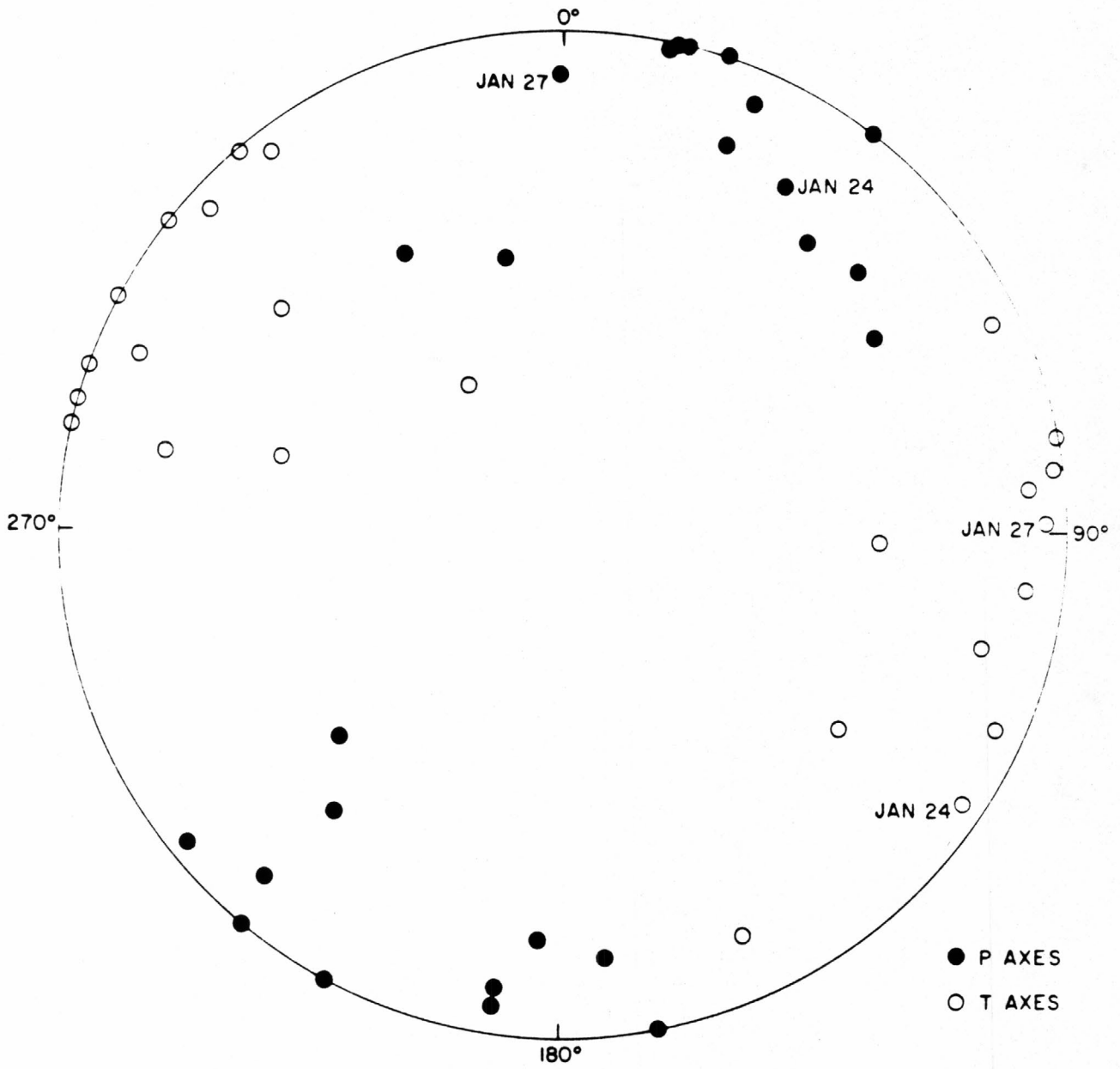


Figure 6

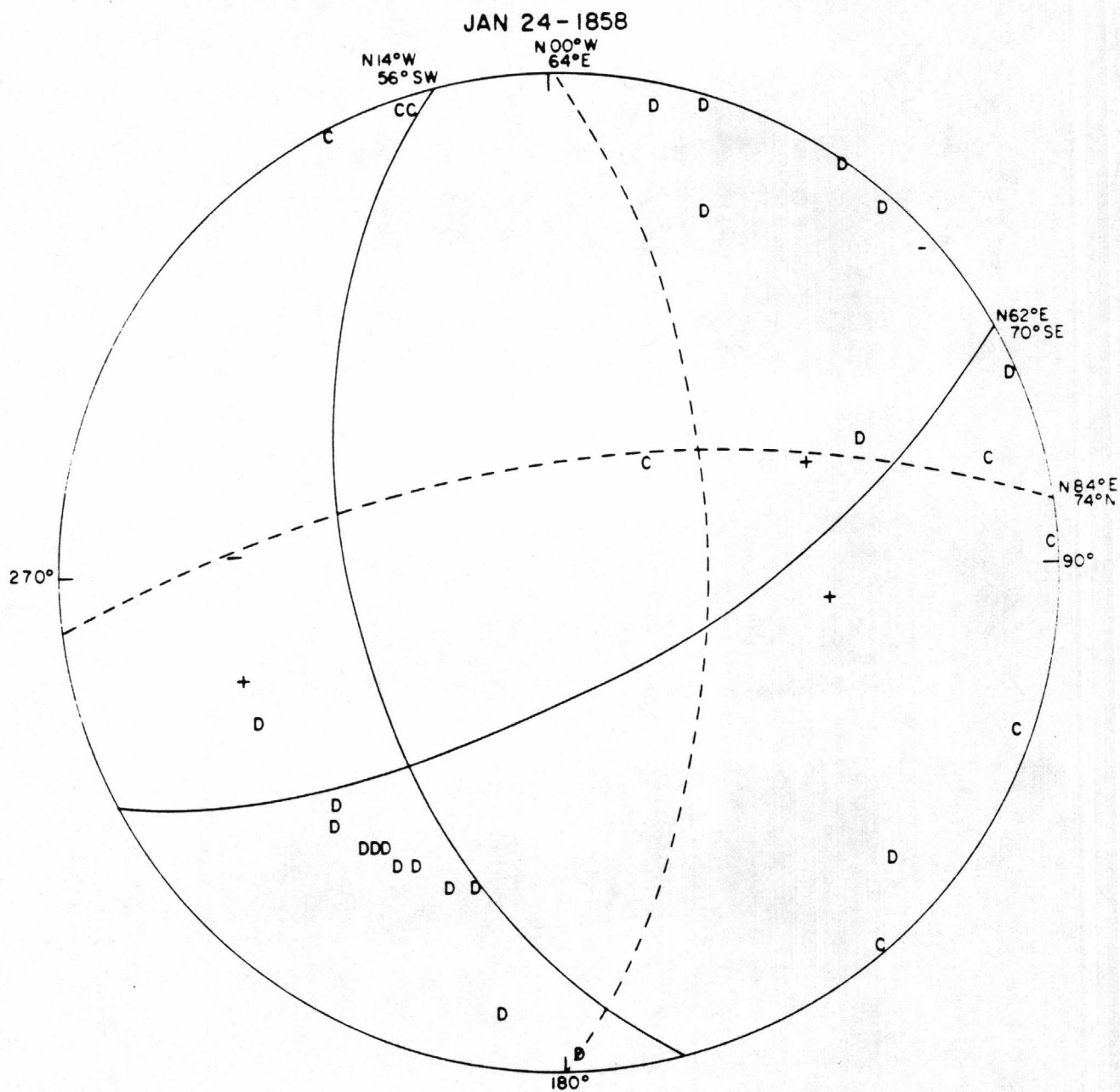


Figure 7

LIVERMORE VALLEY EARTHQUAKES

THE B VALUE IS 0.817, FOR MAG GREATER THAN 1.60

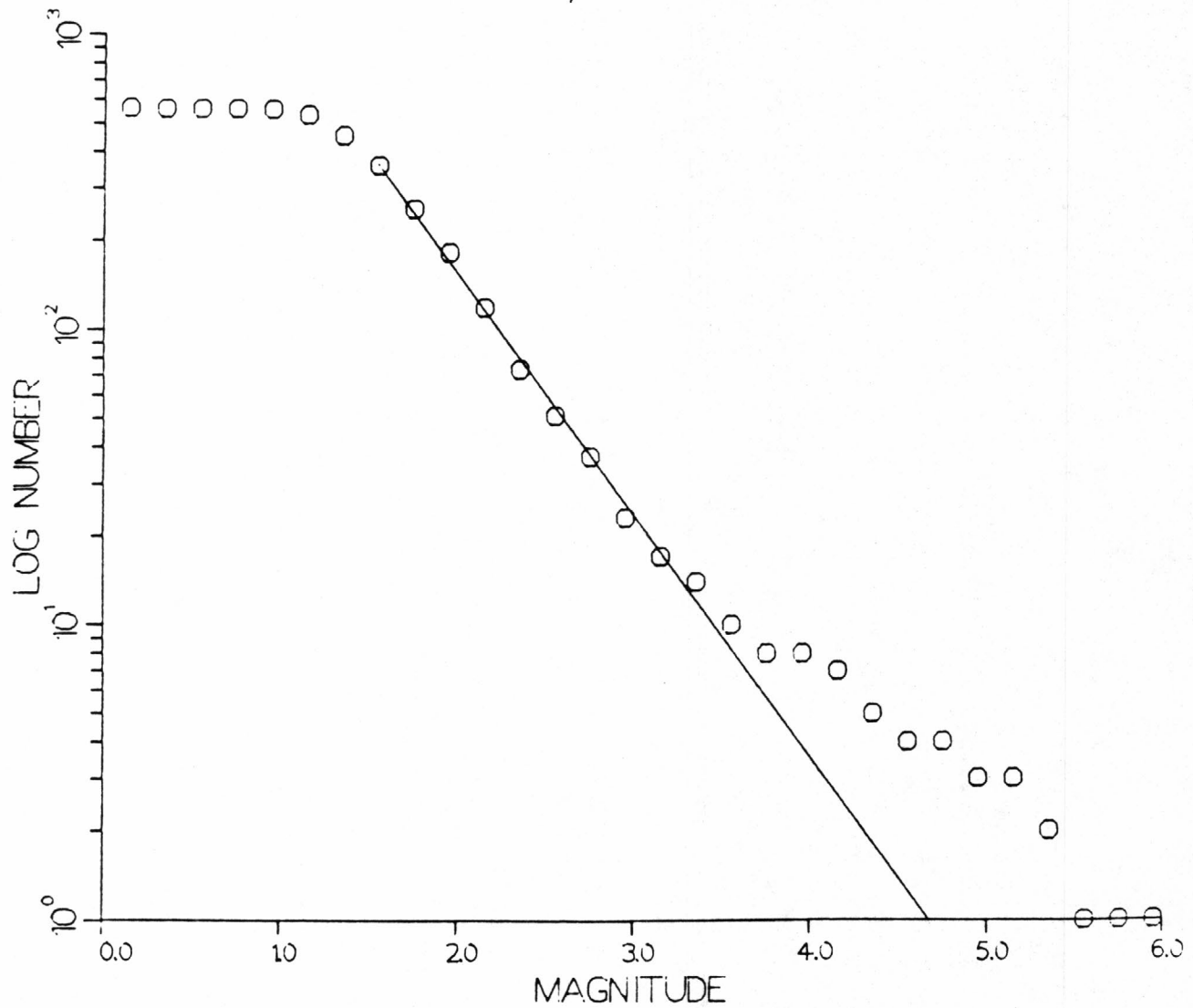


Figure 8

LIVERMORE VALLEY EARTHQUAKES

MAGNITUDE > 1.60

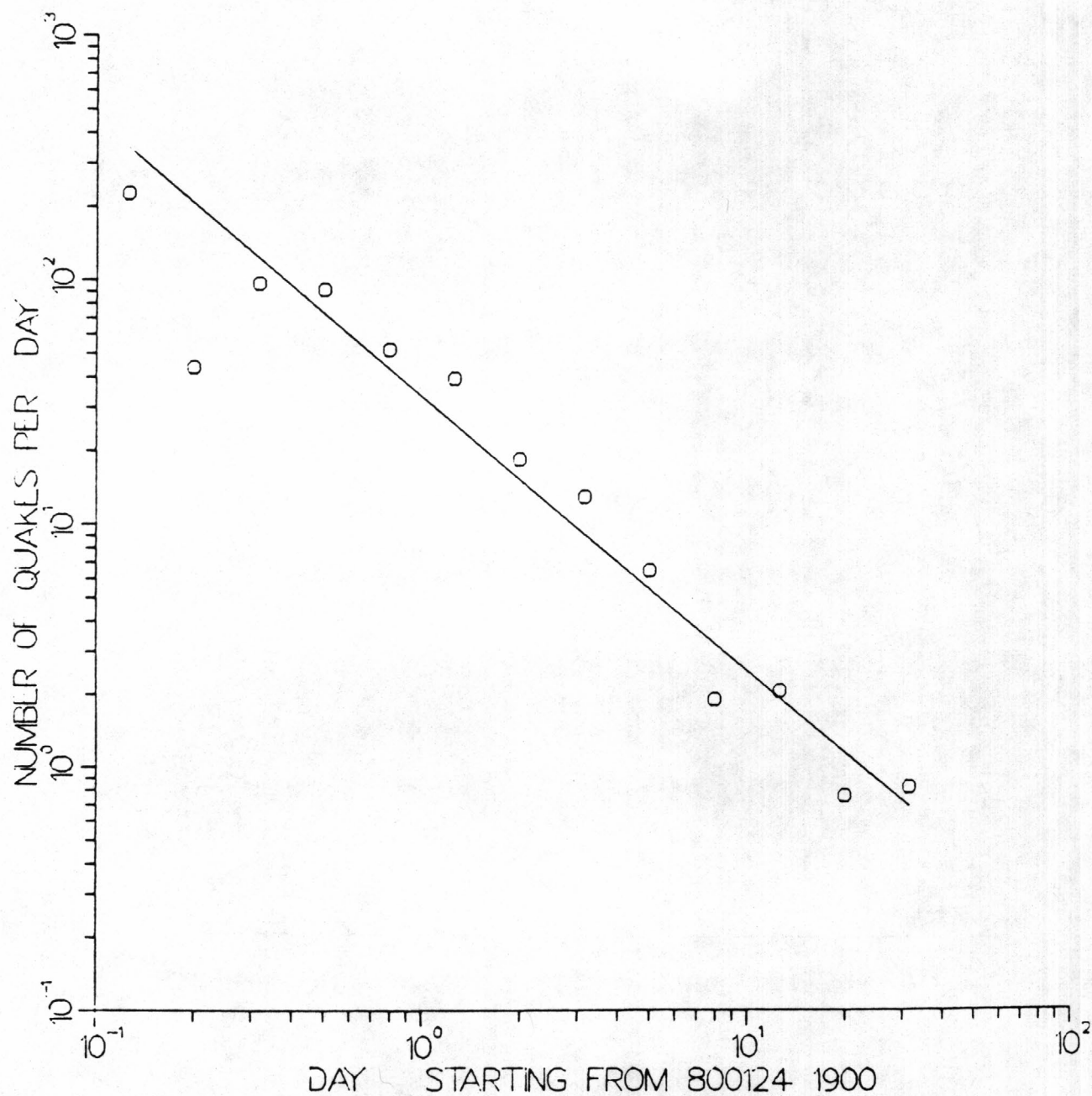


Figure 9

