GEOLOGICAL SURVEY CIRCULAR 788–D

Earthquakes in the United States October–December 1977

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By C. W. Stover, J. H. Minsch, and R. B. Simon

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1979

United States Department of the Interior

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Geological Survey

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CONTENTS

ILLUSTRATIONS

TABLES

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INTRODUCTION

The earthquake information in this publication supplements that published in the NEIS (National Earthquake Information Service) publications, PDE ("Preliminary Determination of Epicenters") and "Preliminary Determination of Epicenters, Monthly Listing," to the extent of providing detailed felt and intensity data, as well as isoseismal maps for U.S. earthquakes. The purpose is to provide a complete listing of macroseismic effects of earthquakes, which can be used in risk studies, nuclear power plant site evaluations, seismicity studies, and answering inquiries by the public.

This publication contains two major sections. The first (table 1) is a tabular listing of earthquakes in chronological order by State, consisting of the following basic information: date, origin time, hypocenter, magnitude, maximum intensity, and computational source of the hypocenter. The second section consists of seven maps and table 2, which lists detailed intensity information. The list of earthquakes in table 1 was compiled from those located in the United States or off the coasts that were published in the PDE; from hypocenters in California above magnitude 3.0, supplied by California Institute of Technology, Pasadena, the University of California, Berkeley, and other offices of the U.S. Geological Survey; from hypocenters in Hawaii supplied by the Hawaiian Volcano Observatory; and from any others that were felt or that caused damage, regardless of magnitude or availability of a hypocenter. Known or suspected explosions are also listed.

The intensities and macroseismic data were compiled from information obtained through questionnaires, from newspaper articles, and with the cooperation of other Government agencies, State institutions, local organizations, and individuals. (See "Acknowledgments" for a list of collaborators.) Figure 1 is the questionnaire in current use by the NEIS. Other versions of this questionnaire are used by State agencies, engineering firms, and other Government agencies to collect intensity data. Anyone wishing to submit felt or damage information on earthquakes for inclusion in future reports should send it to the National Earthquake Information Service, Stop 967, Box 25046, Denver Federal Center, Denver, CO 80225. Copies of the current "Earthquake Report" questionnaire can be obtained at this address.

The primary method used by the NEIS to collect macroseismic information is a questionnaire canvass using the "Earthquake Report" forms, which are mailed to postmasters in the area affected by the earthquake. The postmasters complete the forms and return them to the NEIS, where they are evaluated and an intensity value is assigned. The intensity observations are mapped and contoured by isoseismals. Isoseismal contours present a generalization of intensity data and an extrapolation of these data to regions from which there are no observations; they do not necessarily account for every individual observation.

The data in table 2 will be included in the "Earthquake Description" section of "United States Earthquakes," an annual publication, to which later data from other sources may be added for the purpose of updating and completeness. "United States Earthquakes" is published jointly by the U.S. Geological Survey, Department of the Interior, and the Environmental Data Service, NOAA, Department of Commerce.

DISCUSSION OF TABLES

The parameters for the earthquakes in table 1 and table 2 include the date, origin time, hypocenter (epicenter and focal depth), magnitude, intensity, and hypocenter source. The origin time and date are listed in Universal Coordinated Time (UTC) and local standard time based on the time-zone maps in figures 2 and 3. The epicenters, which were taken from those published in the PDE, or from other sources as noted, are listed here to two decimals. The accuracy of the epicenters is that claimed by the institution

U.S. DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

EARTHQUAKE REPORT

Form Approved
OMB No. 42-R1700

Please answer this questionnaire carefully and return as soon as possible.

1. Was an earthquake felt by anyone in your town or zip code area recently?
   - ☐ Not felt: Please refold and tape for return mail.
   - ☐ Felt: Date_____ Time_____ ☐ AM ☐ PM ☐ Standard time ☐ Daylight time

Name of person filling out form _____

Address_____

City_____ County_____

State_____ Zip code_____

If you felt the earthquake, complete the following section. If others felt the earthquake but you did not, skip the personal report and complete the community report.

PERSONAL REPORT

2a. Did you personally feel the earthquake? 1☐ Yes ☐ No
b. Were you awakened by the earthquake? 2☐ Yes ☐ No
c. Were you frightened by the earthquake? 3☐ Yes ☐ No
d. Were you at 4☐ Home 5☐ Work 6☐ Other?
e. Town and zip code of your location at time of earthquake _____

f. Check your activity when the earthquake occurred:
7☐ Walking 8☐ Sleeping 9☐ Lying down 10☐ Standing
11☐ Driving (car in motion) 12☐ Sitting 13☐ Other
g. Were you 14☐ Inside or 15☐ Outside?
h. If inside, on what floor were you? 16☐☐

Continue on to next section which should include personal as well as reported observations.

COMMUNITY REPORT

Check one box for each question that is applicable.

3a. The earthquake was felt by	☐ No one	17☐ Few	18☐ Several	19☐ Many	20☐ All?
b. This earthquake awakened	☐ No one	21☐ Few	22☐ Several	23☐ Many	24☐ All?
c. This earthquake frightened	☐ No one	25☐ Few	26☐ Several	27☐ Many	28☐ All?

4. What outdoor physical effects were noted in your community?

Parapets or cornices fallen	29☐ Yes	☐ No	
Trees and bushes shaken	30☐ Slightly	31☐ Moderately	32☐ Strongly
Standing vehicles rocked	33☐ Slightly	34☐ Moderately	35☐ Strongly
Moving vehicles rocked	36☐ Slightly	37☐ Moderately	38☐ Strongly
Ground cracks	39☐ Wet ground	40☐ Steep slopes	41☐ Dry and level ground
Landslides	42☐ Small	43☐ Large	
Underground pipes	44☐ Broken	45☐ Out of service	
Water splashed onto sides of lakes, ponds, swimming pools	46☐ Yes	☐ No	
Elevated water tanks	47☐ Cracked	48☐ Twisted	49☐ Fallen (thrown down)
Air coolers	50☐ Displaced	51☐ Rotated	52☐ Fallen
Railroad tracks bent	53☐ Slightly	54☐ Greatly	
Stone or brick fences	55☐ Cracked	56☐ Fallen	57☐ Destroyed
Tombstones	58☐ Displaced 61☐ Fallen	59☐ Cracked	60☐ Rotated
Chimneys	62☐ Cracked	63☐ Twisted	64☐ Fallen
	65☐ Broken at roof line		66☐ Bricks fallen
Highways or streets	67☐ Cracked slightly	68☐ Large cracks	69☐ Displaced
Sidewalks	70☐ Cracked slightly	71☐ Large cracks	72☐ Displaced

Continued on the reverse side

FIGURE 1.--Example of the "Earthquake Report" form used for evaluating the intensities of earthquakes. A, front side.

5. What indoor physical effects were noted in your community?

Windows, doors, dishes rattled	73 ☐ Yes	☐ No		
Buildings creaked	74 ☐ Yes	☐ No		
Building trembled (shook)	75 ☐ Yes	☐ No		
Hanging pictures	76 ☐ Swung	77 ☐ Out of place	78 ☐ Fallen	
Water in small containers	79 ☐ Spilled	80 ☐ Slightly disturbed		
Windows	81 ☐ Few cracked	82 ☐ Some broken	83 ☐ Many broken	

6a. Did hanging objects, doors swing? ☐ No 84 ☐ Slightly 85 ☐ Moderately 86 ☐ Violently

b. Can you estimate direction? ☐ No 87 ☐ North/South 88 ☐ East/West 89 ☐ Other

7a. Were small objects (dishes, knick-knacks, pictures) ☐ Unmoved 90 ☐ Shifted 91 ☐ Overturned 92 ☐ Fallen, not broken 93 ☐ Broken?

b. Was light furniture ☐ Unmoved 94 ☐ Shifted 95 ☐ Overturned 96 ☐ Fallen, not broken 97 ☐ Broken?

c. Were heavy furniture or appliances ☐ Unmoved 98 ☐ Overturned 99 ☐ Shifted 100 ☐ Broken?

8. Indicate effects of the following types to interior walls if any:

Plaster	101 ☐ Cracked	102 ☐ Fell
Dry wall	103 ☐ Cracked	104 ☐ Fell
Ceiling tiles	105 ☐ Cracked	106 ☐ Fell

9a. Check below any damage to buildings or structures.

Foundation	107 ☐ Cracked	108 ☐ Destroyed		
Interior walls	109 ☐ Split	110 ☐ Fallen	111 ☐ Separated from ceiling or floor	
Exterior walls	112 ☐ Hairline cracks	113 ☐ Large cracks	114 ☐ Bulged outward	
	115 ☐ Partial collapse	116 ☐ Total collapse		
Building	117 ☐ Moved on foundation	118 ☐ Shifted off foundation		

b. What type of construction was the building that showed this damage?

119 ☐ Wood	120 ☐ Stone	121 ☐ Brick veneer	122 ☐ Other
123 ☐ Brick	124 ☐ Cinderblock	125 ☐ Reinforced concrete	

c. What was the type of ground under the building?

126 ☐ Don't know	127 ☐ Sandy soil	128 ☐ Marshy	129 ☐ Fill
130 ☐ Hard rock	131 ☐ Clay soil	132 ☐ Sandstone, limestone, shale	

d. Was the ground: 133 ☐ Level 134 ☐ Sloping 135 ☐ Steep?

e. Check the approximate age of the building:

136 ☐ Built before 1935 137 ☐ Built 1935-65 138 ☐ Built after 1965

10a. What percentage of buildings were damaged?

Within 2 city blocks of your location ☐ None 139 ☐ Few (about 5%) 140 ☐ Many(about 50%) 141 ☐ Most (about 75%)

b. In area covered by your zip code ☐ None 142 ☐ Few (about 5%) 143 ☐ Many (about 50%) 144 ☐ Most (about 75%)

11a. Were springs or well water disturbed? 145 ☐ Level changed 146 ☐ Flow disturbed 147 ☐ Muddied ☐ Don't know

b. Were rivers or lakes changed? 148 ☐ Yes ☐ No ☐ Don't know

12a. Was there earth noise? ☐ No 149 ☐ Faint 150 ☐ Moderate 151 ☐ Loud

b. Direction of noise 152 ☐ North 153 ☐ South 154 ☐ East 155 ☐ West

c. Estimated duration of shaking 156 ☐ Sudden, sharp (less than 10 secs) 157 ☐ Long (30-60 secs) 158 ☐ Short (10-30 secs) 159 ☐ Other

13. What is the approximate population of your city/town? Or are you in a

160 ☐ Less than 1,000 161 ☐ 10,000 to 100,000 164 ☐ Rural area?

162 ☐ 1,000 to 10,000 163 ☐ Over 100,000

This community report is associated with what town or zip code? _____

Thank you for your time and information. Refold this card and tape for return mail.

FIGURE 1.--Example of the "Earthquake Report" form used for evaluating the intensities of earthquakes. B, reverse side.

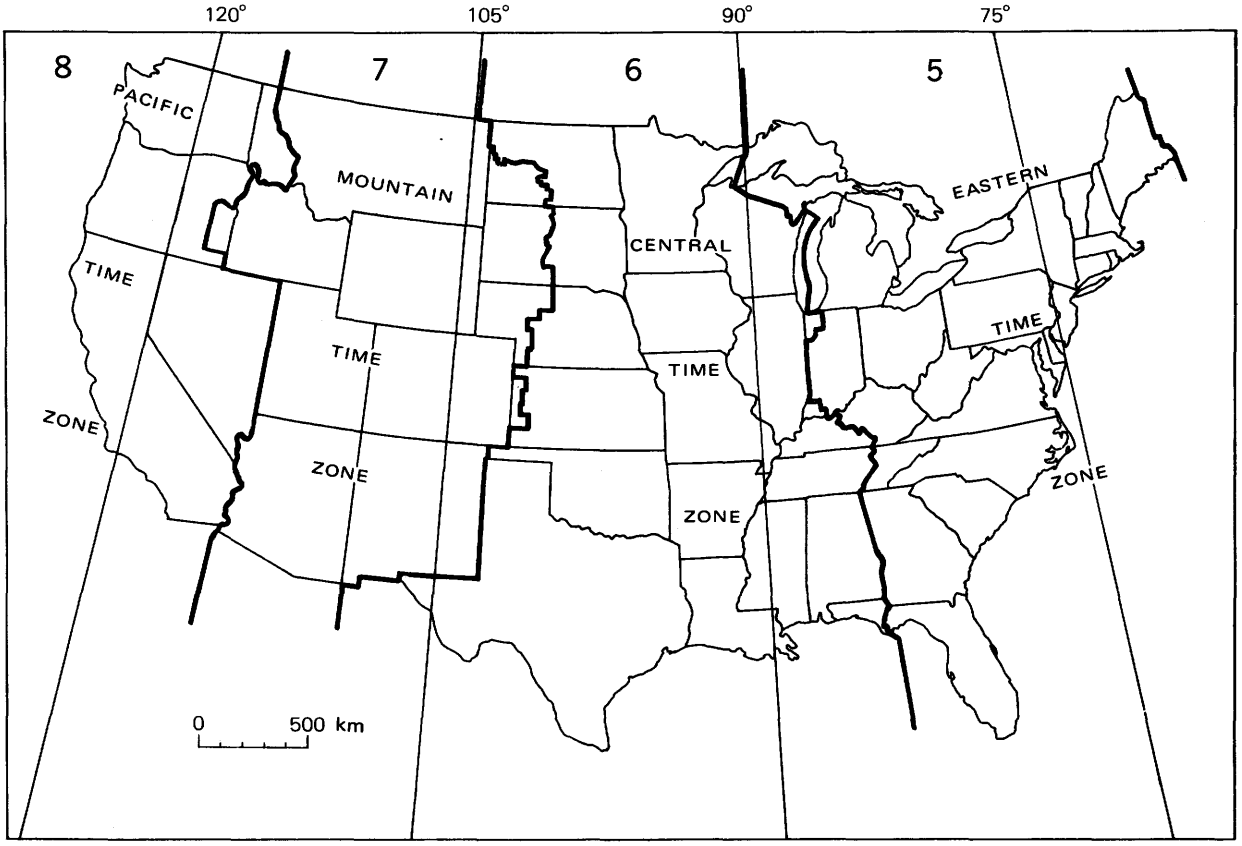

FIGURE 2.--Standard time zones of the conterminous United States. The number in each zone shows the number of hours to be subtracted from Universal Coordinated Time to convert to local standard time. (Subtract 1 hour less for local daylight-saving time.)

supplying the hypocenter and is not necessarily the accuracy indicated by the number of decimals listed. The epicenters located by the NEIS have a varying degree of accuracy, usually two-tenths of a degree or less, depending on their continental or oceanic location. The oceanic hypocenters are less accurate than those on the continent, even though both are listed to two decimals. Depths are listed to the nearest whole kilometer.

Figures 4-6 are maps summarizing the earthquake activity for the conterminous United States, Alaska, and Hawaii for the period October-December 1977. The annual summaries are shown in figures 7-9. The magnitudes plotted in these figures are based on ML or mbLg; if neither was computed, then on MS; and finally on mb, when it was the only magnitude computed.

The magnitude values listed in tables 1 and 2 were furnished by cooperating institutions or determined by the NEIS. The computational sources are labeled according to the assigned letter codes shown in headnotes to tables 1 and 2; the letter follows the value listed under the column heading "Magnitude." In table 1 the absence of a letter code indicates that the NEIS is the source. In table 2 the magnitude source is the same as the location source unless indicated otherwise, by an alphabetic character to the right of the magnitude value. The magnitude values calculated by the NEIS are based on the following formulas:

$$MS=\log(A/T)+1.66\log D+3.3, \quad (1)$$

as adopted by the International Association of Seismology and Physics of the Earth's Interior (IASPEI; Bath, 1966, p. 153), where A is the maximum horizontal surface-wave ground amplitude, in micrometers; T is the period, in seconds, and $18 \leq T \leq 22$; and D is the distance, in geocentric degrees (station to epicenter), and $20^\circ \leq D \leq 160^\circ$. No depth correction is made for depths less than 50 km.

$$mb=\log(A/T)+Q(D,h), \quad (2)$$

as defined by Gutenberg and Richter (1956), except that T, the period in seconds, is restricted to $0.1 \leq T \leq 3.0$, and A, the ground amplitude in micrometers, is not necessarily the maximum of the P-wave group. Q is a function of distance D and depth h, where $D \geq 5^\circ$.

$$ML=\log A-\log A_o, \quad (3)$$

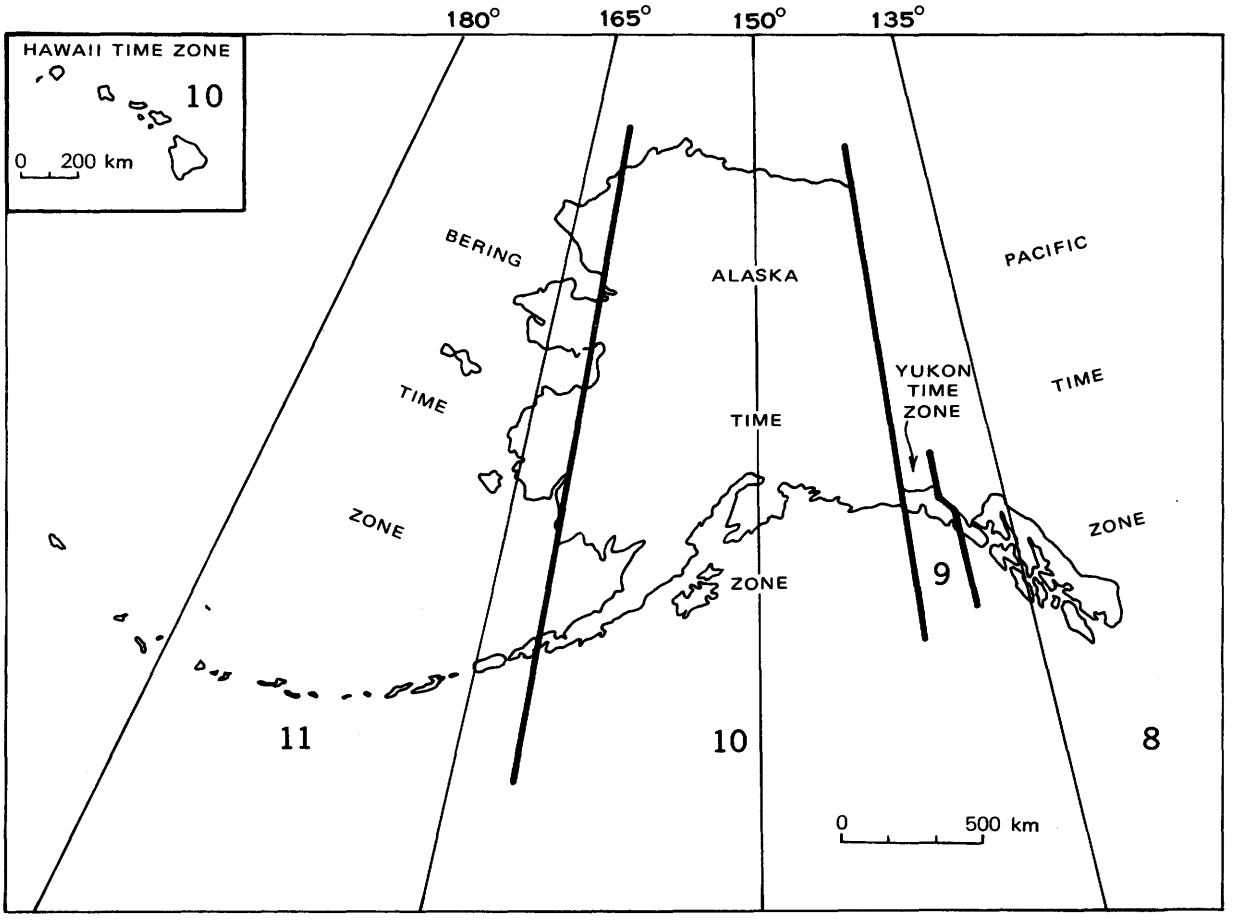

FIGURE 3.--Standard time zones of Alaska and Hawaii. The number in each zone shows the number of hours to be subtracted from Universal Coordinated Time to convert to local standard time. (Subtract 1 hour less for local daylight-saving time.)

as defined by Richter (1958, p. 340), where A is the maximum trace amplitude in millimeters, written by a Wood-Anderson torsion seismometer, and log A is a standard value as a function of distance, where the distance is $\leq$600 km. ML values are also calculated from other seismometers by conversion of recorded ground motion to the expected response of the torsion seismometer.

$$mbLg=3.75+0.90(logD)+log(A/T) \quad (4)$$
$$0.5^{\circ} \leq D \leq 4^{\circ},$$

$$mbLg=3.30+1.66(logD)+log(A/T)$$
$$4^{\circ} \leq D \leq 30^{\circ},$$

as proposed by Nuttli (1973), where A/T is expressed in micrometers per second, calculated from the vertical-component 1-second Lg waves, and D is the distance in geocentric degrees.

All of the intensity values (indicated by Roman numerals) listed in this summary were derived, using the Modified Mercalli Intensity Scale of 1931 (Wood and Neumann, 1931) shown below, from the evaluation of "Earthquake Report" forms; from field reports by U.S. Geological Survey personnel, engineering firms, or universities; and from detailed macroseismic data communicated to the NEIS by people in the area affected by the earthquake. All earthquake reports received which contain minimal information are assigned an Intensity II. These reports are filed in the offices of the NEIS or in government archives and are available for detailed study.

MODIFIED MERCALLI INTENSITY SCALE OF 1931

Adapted from Sieberg's Mercalli-Cancani scale, modified and condensed.

I. Not felt - or, except rarely under especially favorable circumstances. Under certain conditions, at and outside the boundary of the area in which a great shock is felt: sometimes birds, animals, reported uneasy or disturbed; sometimes

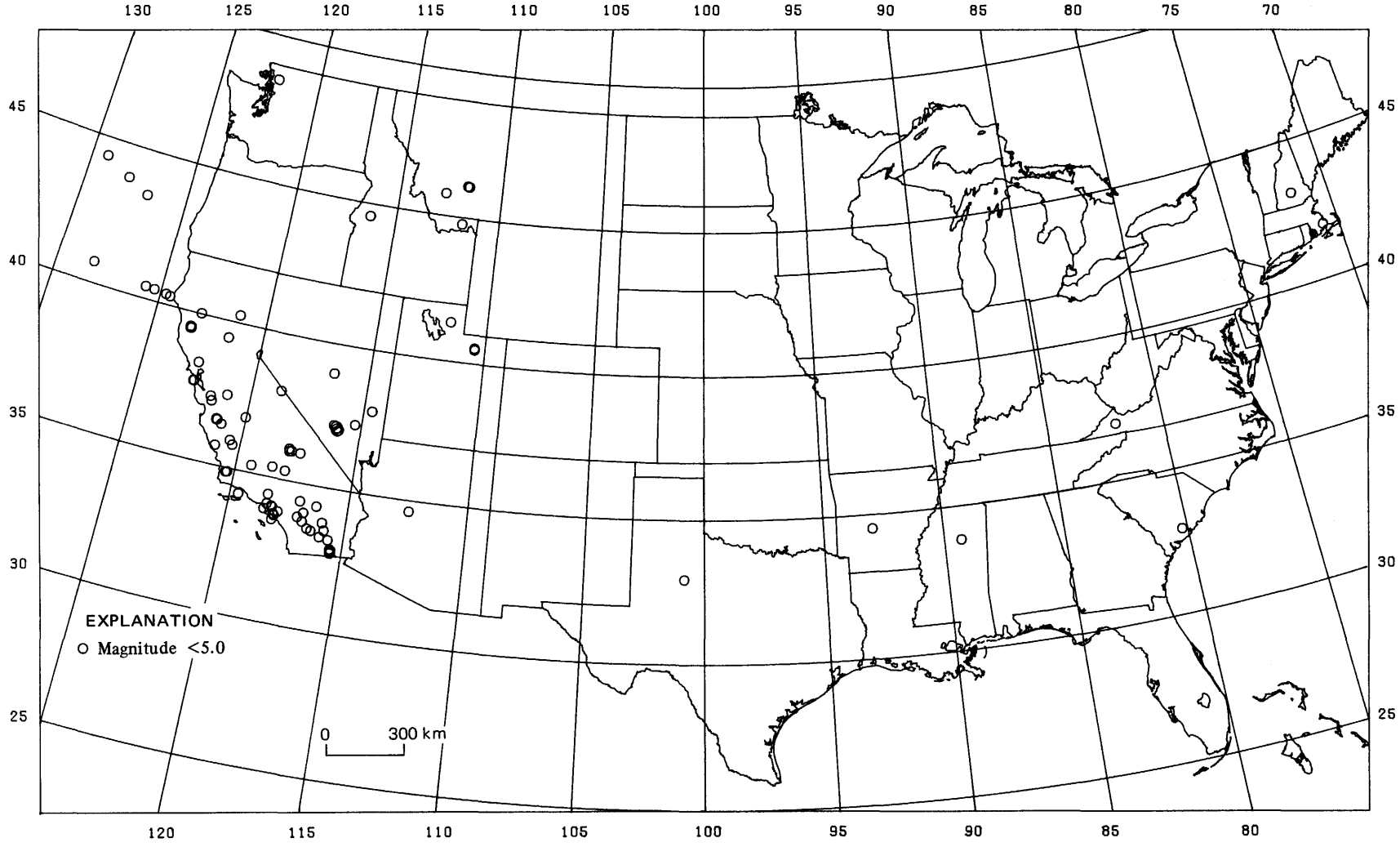

FIGURE 4.--Earthquake epicenters in the conterminous United States for October-December 1977, plotted from table 1.

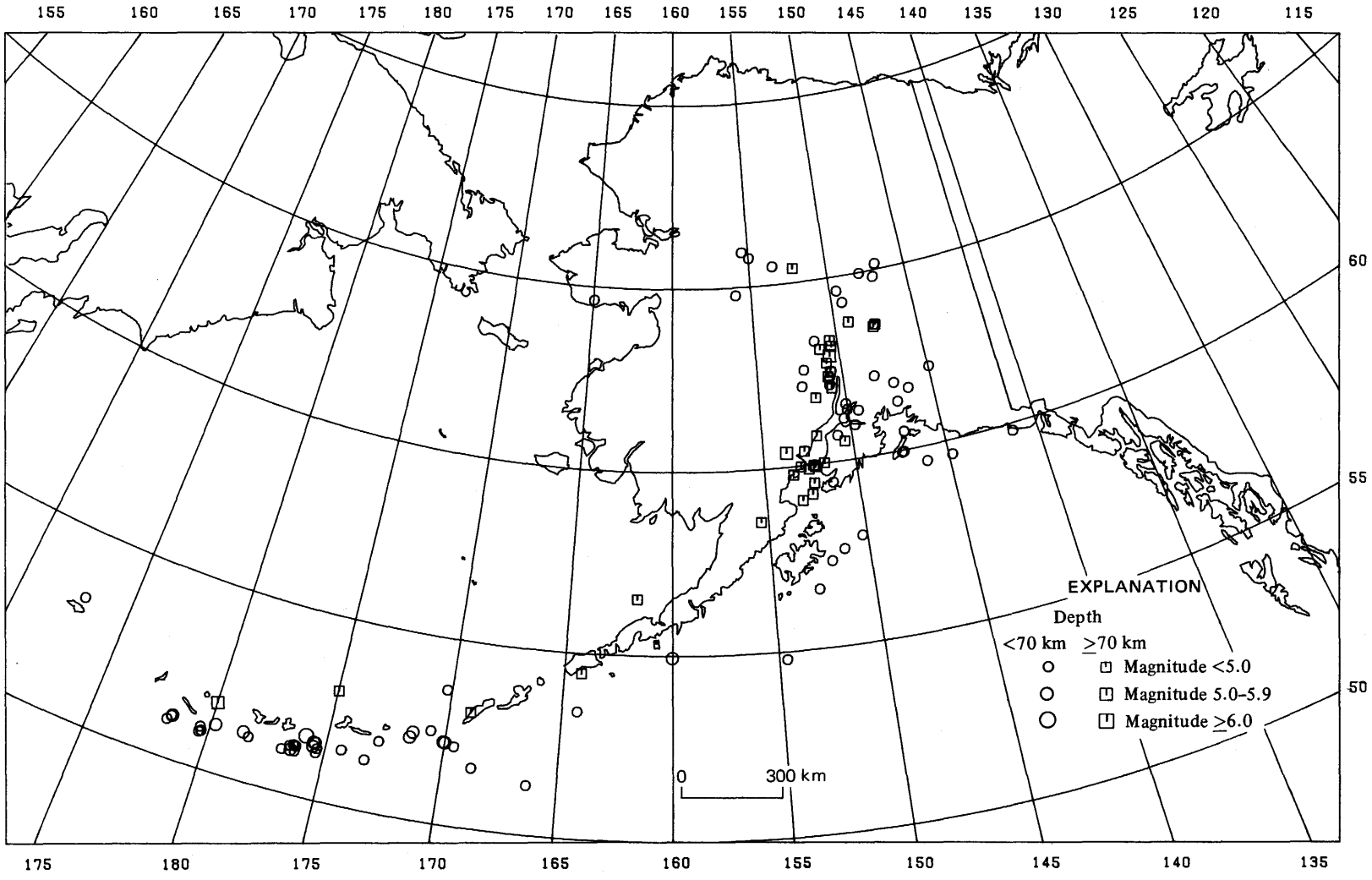

FIGURE 5.--Earthquake epicenters in Alaska for October-December 1977, plotted from table 1.

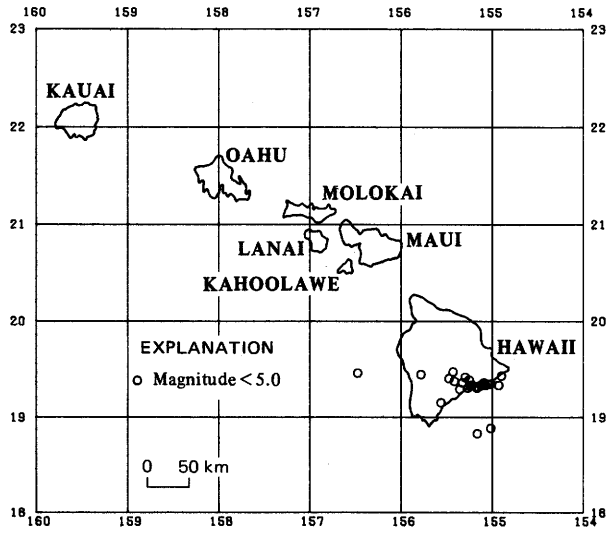

FIGURE 6.--Earthquake epicenters in Hawaii for October-December 1977, plotted from table 1.

dizziness or nausea experienced; sometimes trees, structures, liquids, bodies of water, may sway--doors may swing, very slowly.

II. Felt indoors by few, especially on upper floors, or by sensitive, or nervous persons. Also, as in grade I, but often more noticeably: sometimes hanging objects may swing, especially when delicately suspended; sometimes trees, structures, liquids, bodies of water, may sway, doors may swing, very slowly; sometimes birds, animals, reported uneasy or disturbed; sometimes dizziness or nausea experienced.

III. Felt indoors by several, motion usually rapid vibration. Sometimes not recognized to be an earthquake at first. Duration estimated in some cases. Vibration like that due to passing of light, or lightly loaded trucks, or heavy trucks some distance away. Hanging objects may swing slightly. Movements may be appreciable on upper levels of tall structures. Rocked standing motor cars slightly.

IV. Felt indoors by many, outdoors by few. Awakened few, especially light sleepers. Frightened no one, unless apprehensive from previous experience. Vibration like that due to passing of heavy or heavily loaded trucks. Sensation like heavy body striking building or falling of heavy objects inside. Rattling of dishes, windows, doors; glassware and crockery clink and clash. Creaking of walls, frame, especially in the upper range of this grade. Hanging objects swung, in numerous instances. Disturbed liquids in open vessels slightly. Rocked standing motor cars noticeably.

V. Felt indoors by practically all, outdoors by many or most: outdoors direction estimated. Awakened many, or most. Frightened few--slight excitement, a few ran outdoors. Buildings trembled throughout. Broke dishes, glassware, to some extent. Cracked windows--in some cases, but not generally. Overturned vases, small or unstable objects, in many instances, with occasional fall. Hanging objects, doors, swing generally or considerably. Knocked pictures against walls, or swung them out of place. Opened, or closed, doors, shutters, abruptly. Pendulum clocks stopped, started or ran fast, or slow. Moved small objects, furnishings, the latter to slight extent. Spilled liquids in small amounts from well-filled open containers. Trees, bushes, shaken slightly.

VI. Felt by all, indoors and outdoors. Frightened many, excitement general, some alarm, many ran outdoors. Awakened all. Persons made to move unsteadily. Trees, bushes, shaken slightly to moderately. Liquid set in strong motion. Small bells rang--church, chapel, school, etc. Damage slight in poorly built buildings. Fall of plaster in small amount. Cracked plaster somewhat, especially fine cracks chimneys in some instances. Broke dishes, glassware, in considerable quantity, also some windows. Fall of knick-knacks, books, pictures. Overturned furniture in many instances. Moved furnishings of moderately heavy kind.

VII. Frightened all--general alarm, all ran outdoors. Some, or many, found it difficult to stand. Noticed by persons driving motor cars. Trees and bushes shaken moderately to strongly. Waves on ponds, lakes, and running water. Water turbid from mud stirred up. Incaving to some extent of sand or gravel stream banks. Rang large church bells, etc. Suspended objects made to quiver. Damage negligible in buildings of good design and construction, slight to moderate in well-built ordinary buildings, considerable in poorly built or badly designed buildings, adobe houses, old walls (especially where laid up without mortar), spires, etc. Cracked chimneys to considerable extent, walls to some extent. Fall of plaster in considerable to large amount, also some stucco. Broke numerous windows, furniture to some extent. Shook down loosened brickwork and tiles. Broke weak chimneys at the roof-line (sometimes

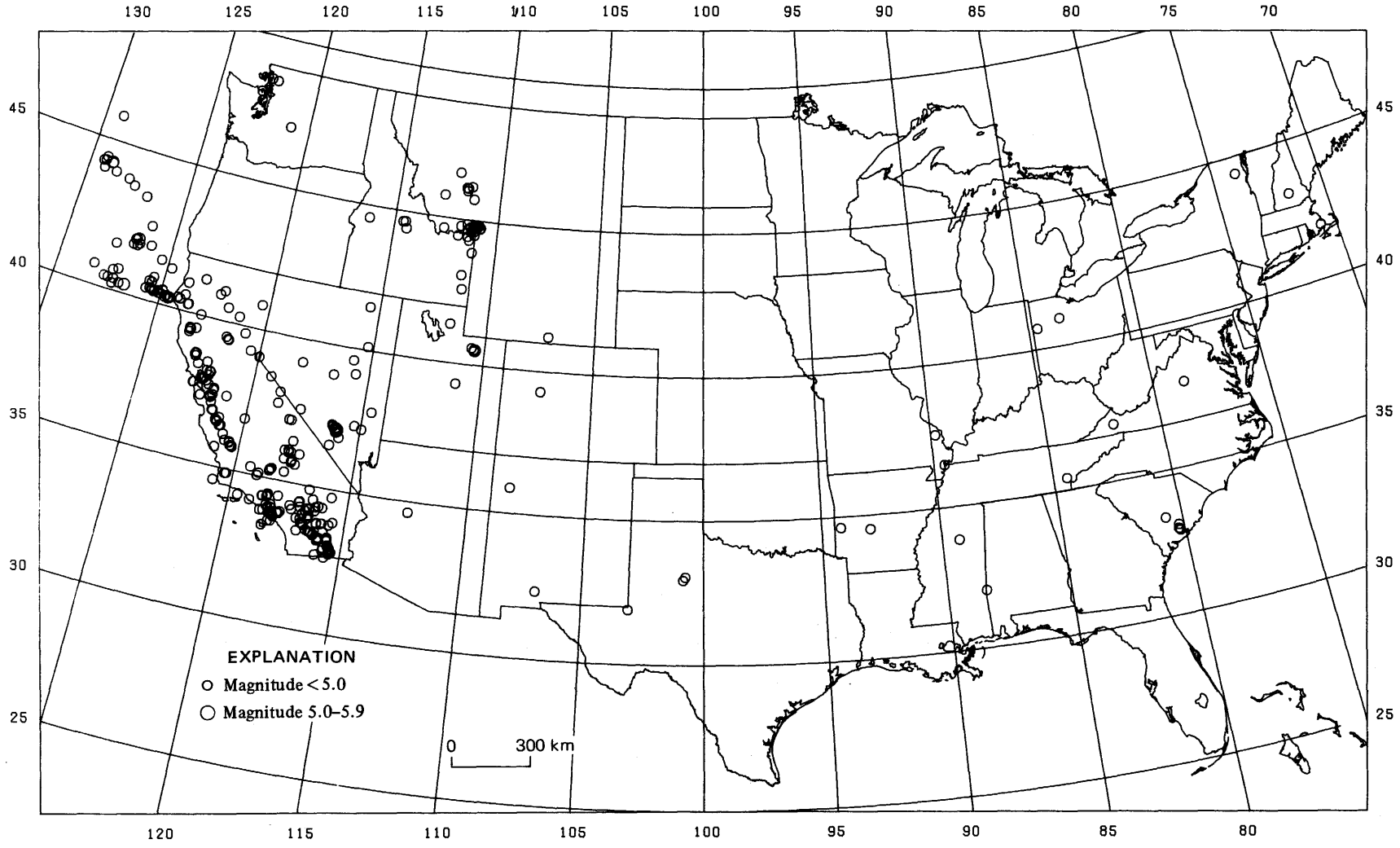

FIGURE 7.--Summary of earthquake epicenters in the conterminous United States for January-December 1977.

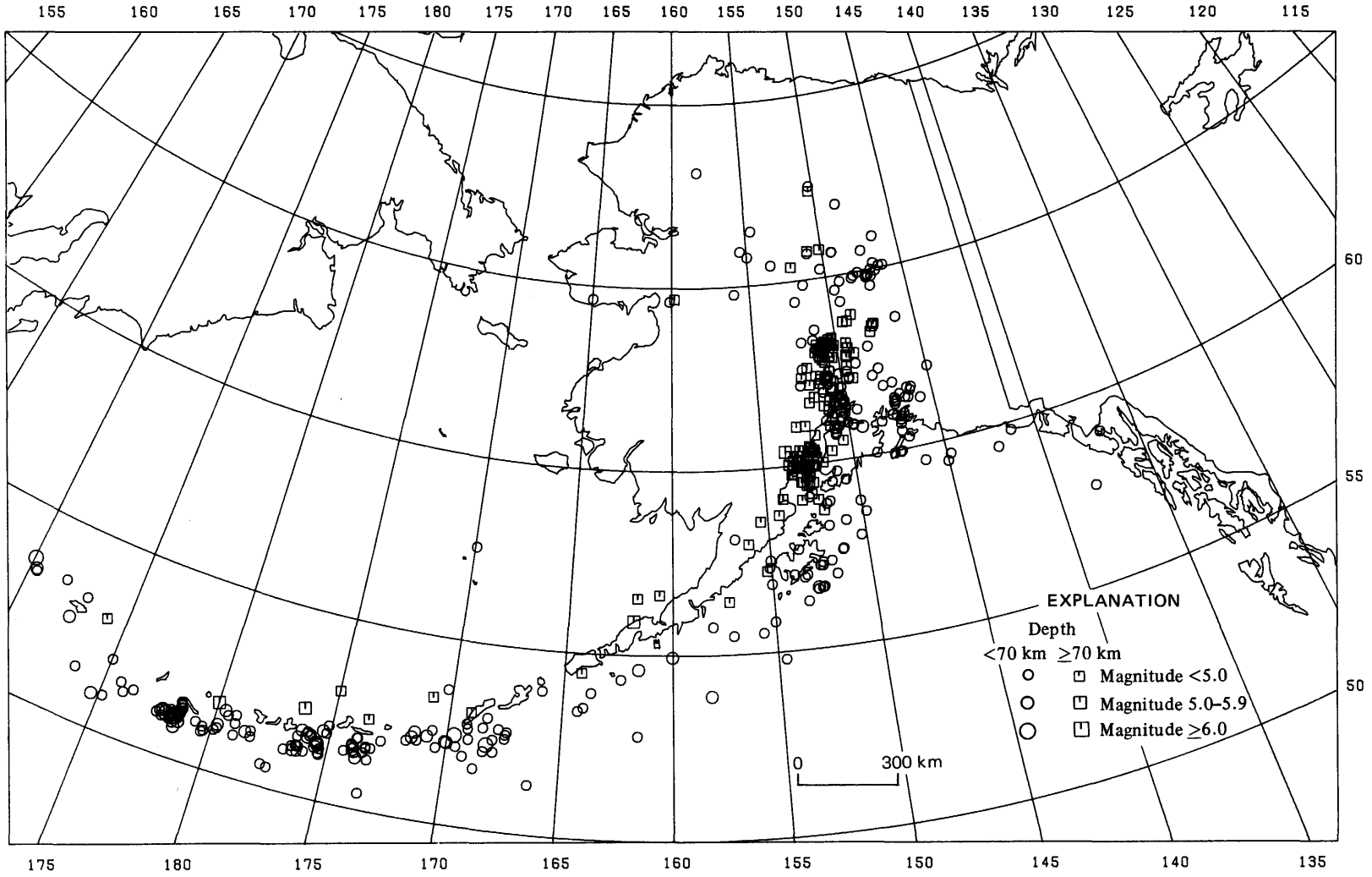

FIGURE 8.--Summary of earthquake epicenters in Alaska for January-December 1977.

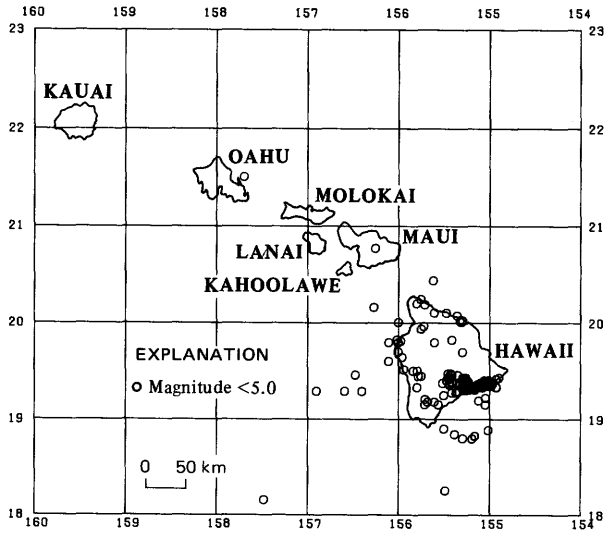

FIGURE 9.--Summary of earthquake epicenters in Hawaii for January-December 1977.

damaging roofs). Fall of cornices from towers and high buildings. Dislodged bricks and stones. Overturned heavy furniture, with damage from breaking. Damage considerable to concrete irrigation ditches.

VIII. Fright general--alarm approaches panic. Disturbed persons driving motor cars. Trees shaken strongly--branches, trunks, broken off, especially palm trees. Ejected sand and mud in small amounts. Changes: temporary, permanent; in flow of springs and wells; dry wells renewed flow; in temperature of spring and well waters. Damage slight in structures (brick) built especially to withstand earthquakes. Considerable in ordinary substantial buildings, partial collapse: racked, tumbled down, wooden houses in some cases; threw out panel walls in frame structures, broke off decayed piling. Fall of walls. Cracked, broke, solid stone walls seriously. Wet ground to some extent, also ground on steep slopes. Twisting, fall, of chimneys, columns, monuments, also factory stacks, towers. Moved conspicuously, overturned, very heavy furniture.

IX. Panic general. Cracked ground conspicuously. Damage considerable in (masonry) structures built especially to withstand earthquakes: Threw out of plumb some wood-frame houses built especially to withstand earthquakes; great in substantial (masonry) buildings, some collapse in large part; or wholly shifted frame buildings off foundations, racked frames; serious to reservoirs; underground pipes sometimes broken.

X. Cracked ground, especially when loose and wet, up to widths of several inches; fissures up to a yard in width ran parallel to canal and stream banks. Landslides considerable from river banks and steep coasts. Shifted sand and mud horizontally on beaches and flat land. Changed level of water in wells. Threw water on banks of canals, lakes, rivers, etc. Damage serious to dams, dikes, embankments. Severe to well-built wooden structures and bridges, some destroyed. Developed dangerous cracks in excellent brick walls. Destroyed most masonry and frame structures, also their foundations. Bent railroad rails slightly. Tore apart, or crushed endwise, pipe lines buried in earth. Open cracks and broad wavy folds in cement pavements and asphalt road surfaces.

XI. Disturbances in ground many and widespread, varying with ground material. Broad fissures, earth slumps, and land slips in soft, wet ground. Ejected water in large amounts charged with sand and mud. Caused sea-waves ("tidal" waves) of significant magnitude. Damage severe to wood-frame structures, especially near shock centers. Great to dams, dikes, embankments often for long distances. Few, if any (masonry) structures remained standing. Destroyed large well-built bridges by the wrecking of supporting piers, or pillars. Affected yielding wooden bridges less. Bent railroad rails greatly, and thrust them endwise. Put pipe lines buried in earth completely out of service.

XII. Damage total--practically all works of construction damaged greatly or destroyed. Disturbances in ground great and varied, numerous shearing cracks. Landslides, falls of rock of significant character, slumping of river banks, etc., numerous and extensive. Wrenched loose, tore off, large rock masses. Fault slips in firm rock, with notable horizontal and vertical offset displacements. Water channels, surface and underground, disturbed and modified greatly. Dammed lakes, produced waterfalls, deflected rivers, etc. Waves seen on ground surfaces (actually seen, probably, in some cases). Distorted lines of sight and level. Threw objects upward into the air.

Table 1.–*Summary of U.S. earthquakes for October–December 1977*

[Sources of the hypocenter and magnitudes: (A) U.S. Department of Energy; (B) University of California, Berkeley; (D) University of Montana, Missoula; (E) Idaho National Engineering Laboratory, Department of Energy, Idaho Falls; (G) U.S. Geological Survey, National Earthquake Information Service; (H) U.S. Geological Survey, Hawaiian Volcano Observatory; (J) Weston Observatory, Massachusetts; (M) NOAA, Alaska Tsunami Warning Center, Palmer; (P) California Institute of Technology, Pasadena; (S) St. Louis University, St. Louis, Missouri; (U) University of Utah, Salt Lake City; (V) Virginia Polytechnic Institute and State University, Blacksburg; (W) University of Washington, Seattle. N, Normal depth; UTC, Universal Coordinated Time. For names of local time zones, see figures 2 and 3. Leaders (...) indicate no information available]

Date (1977)	Origin time (UTC) hr	min	s	Lat	Long	Depth (km)	Magnitude mb	MS	ML or mbLg	Maximum intensity	Hypocenter source	Local time Date	Hour
ALASKA													
OCT. 3	13	31	16.4	65.15 N.	146.84 W.	33	...	...	3.3M	III	G	OCT. 3	03 A.M. AST
OCT. 4	16	52	24.1	62.57 N.	152.23 W.	46	...	...	...	...	G	OCT. 4	06 A.M. AST
OCT. 5	19	40	21.4	61.78 N.	151.71 W.	108	3.8	...	...	...	G	OCT. 5	09 A.M. AST
OCT. 8	22	50	04.0	64.79 N.	155.99 W.	45	...	...	...	...	G	OCT. 8	12 P.M. AST
OCT. 11	05	03	11.6	51.14 N.	176.84 W.	33N	4.7	...	...	...	G	OCT. 10	06 P.M. BST
OCT. 11	16	50	52.3	63.09 N.	151.08 W.	141	...	...	...	...	G	OCT. 11	06 A.M. AST
OCT. 11	22	32	56.9	62.31 N.	150.83 W.	71	...	...	...	...	G	OCT. 11	12 P.M. AST
OCT. 12	12	55	49.8	59.97 N.	152.30 W.	115	4.1	...	...	...	G	OCT. 12	02 A.M. AST
OCT. 13	00	8	14.7	51.30 N.	178.58 W.	28	4.8	5.3	...	...	G	OCT. 12	01 P.M. BST
OCT. 16	04	25	40.0	59.88 N.	152.55 W.	82	4.6	...	...	V	G	OCT. 15	06 P.M. AST
OCT. 16	16	29	04.5	59.05 N.	153.06 W.	87	4.7	...	...	...	G	OCT. 16	06 A.M. AST
OCT. 16	22	04	14.0	63.13 N.	150.39 W.	134	...	...	...	...	G	OCT. 16	12 P.M. AST
OCT. 18	07	03	53.5	54.80 N.	154.63 W.	33N	4.9	...	...	...	G	OCT. 17	09 P.M. AST
OCT. 18	10	48	37.3	60.70 N.	150.79 W.	33N	3.7	...	3.4M	II	G	OCT. 18	00 A.M. AST
OCT. 19	02	16	02.6	62.88 N.	150.56 W.	102	5.0	...	...	III	G	OCT. 18	04 P.M. AST
OCT. 21	19	09	47.2	52.35 N.	171.44 W.	67	5.3	...	...	...	G	OCT. 21	08 A.M. BST
OCT. 24	07	09	41.2	56.53 N.	161.72 W.	198	4.7	...	...	...	G	OCT. 23	08 P.M. BST
OCT. 26	15	10	58.8	51.15 N.	178.33 E.	33N	5.6	5.2	...	...	G	OCT. 26	04 A.M. BST
OCT. 27	08	53	20.5	64.65 N.	164.97 W.	33N	...	...	...	II	G	OCT. 26	09 P.M. BST
OCT. 28	08	53	34.5	60.91 N.	149.72 W.	26	...	...	3.4M	II	G	OCT. 27	10 P.M. AST
OCT. 30	10	51	58.4	59.79 N.	141.32 W.	33N	...	...	4.1M	...	G	OCT. 30	00 A.M. AST
OCT. 30	12	16	07.0	61.34 N.	147.12 W.	26	...	...	3.1M	...	G	OCT. 30	02 A.M. AST
OCT. 31	23	03	20.7	53.11 N.	169.07 W.	97	4.5	...	...	...	G	OCT. 31	12 P.M. BST
NOV. 2	10	06	35.9	60.49 N.	147.12 W.	33N	...	...	3.0M	...	G	NOV. 2	00 A.M. AST
NOV. 4	01	22	26.5	61.13 N.	150.30 W.	42	...	...	...	II	G	NOV. 3	03 P.M. AST
NOV. 4	09	52	55.7	51.66 N.	175.95 W.	33N	5.7	6.7	...	VI	G	NOV. 3	10 P.M. BST
NOV. 4	10	02	03.7	51.53 N.	175.50 W.	33N	5.2	...	...	...	G	NOV. 3	11 P.M. BST
NOV. 4	11	04	14.9	51.39 N.	175.35 W.	33N	4.7	...	...	...	G	NOV. 4	00 A.M. BST
NOV. 4	18	07	31.3	51.43 N.	175.56 W.	33N	5.4	5.4	...	IV	G	NOV. 4	07 A.M. BST
NOV. 5	09	49	17.6	63.72 N.	149.15 W.	159	...	...	...	...	G	NOV. 4	11 P.M. AST
NOV. 5	14	44	03.3	51.54 N.	175.55 W.	33N	5.3	5.6	...	...	G	NOV. 5	03 A.M. BST
NOV. 6	07	34	25.4	51.26 N.	179.81 W.	33N	5.0	...	...	...	G	NOV. 5	08 P.M. BST
NOV. 6	09	23	28.2	61.99 N.	150.73 W.	78	4.1	...	...	...	G	NOV. 5	11 P.M. AST
NOV. 6	15	25	40.8	51.27 N.	175.39 W.	33N	4.8	...	...	...	G	NOV. 6	04 A.M. BST
NOV. 6	18	42	14.3	51.22 N.	178.34 W.	33N	4.6	...	...	...	G	NOV. 6	07 A.M. BST
NOV. 6	19	11	02.7	62.10 N.	144.94 W.	33N	...	...	3.3M	II	G	NOV. 6	09 A.M. AST
NOV. 7	05	32	44.9	57.32 N.	151.93 W.	45	4.5	...	...	...	G	NOV. 6	07 P.M. AST
NOV. 12	02	23	47.6	53.63 N.	170.24 W.	33N	4.2	...	...	...	G	NOV. 11	03 P.M. BST
NOV. 13	13	22	01.0	51.01 N.	178.13 E.	29	4.8	...	...	...	G	NOV. 13	02 A.M. BST
NOV. 14	19	29	01.8	52.48 N.	170.69 W.	69	4.9	...	...	...	G	NOV. 14	08 A.M. BST
NOV. 15	00	43	53.8	62.09 N.	150.80 W.	10	...	...	3.1M	...	G	NOV. 14	02 P.M. AST
NOV. 15	04	57	14.0	54.95 N.	160.03 W.	39	5.1	...	...	...	G	NOV. 14	06 P.M. AST
NOV. 15	16	48	44.9	60.51 N.	150.44 W.	77	...	...	...	...	G	NOV. 15	06 A.M. AST
NOV. 16	09	56	56.1	62.70 N.	150.84 W.	93	...	...	...	...	G	NOV. 15	11 P.M. AST
NOV. 16	15	29	30.6	51.11 N.	179.59 E.	68	4.7	...	...	...	G	NOV. 16	04 A.M. BST
NOV. 16	18	44	44.2	50.97 N.	179.58 E.	64	4.5	...	...	...	G	NOV. 16	07 A.M. BST
NOV. 16	19	02	23.1	51.00 N.	179.68 E.	60	3.9	...	...	...	G	NOV. 16	08 A.M. BST
NOV. 17	03	33	56.0	64.97 N.	147.91 W.	16	...	...	3.9M	IV	G	NOV. 16	05 P.M. AST

Table 1.–*Summary of U.S. earthquakes for October-December 1977*–Continued

Date (1977)	Origin time (UTC) hr	min	s	Lat	Long	Depth (km)	Magnitude mb	MS	ML or mbLg	Maximum intensity	Hypocenter source	Local time Date	Hour
ALASKA--Continued													
NOV. 17	05	00	09.6	64.61 N.	149.54 W.	25	...	...	3.3M	II	G	NOV. 16	07 P.M. AST
NOV. 17	05	54	29.2	65.38 N.	152.13 W.	203	...	...	...	...	G	NOV. 16	07 P.M. AST
NOV. 17	12	27	06.3	61.29 N.	149.40 W.	39	...	...	...	III	G	NOV. 17	02 A.M. AST
NOV. 18	10	36	31.4	60.01 N.	151.69 W.	83	...	...	...	...	G	NOV. 18	00 A.M. AST
NOV. 18	20	20	08.4	62.15 N.	152.44 W.	33N	...	...	3.2M	...	G	NOV. 18	10 A.M. AST
NOV. 19	22	03	48.3	51.49 N.	174.32 W.	47	4.7	...	...	...	G	NOV. 19	11 A.M. BST
NOV. 20	18	53	57.8	62.43 N.	150.66 W.	79	4.9	...	...	V	G	NOV. 20	08 A.M. AST
NOV. 21	13	34	32.9	59.19 N.	152.52 W.	133	...	...	...	...	G	NOV. 21	03 A.M. AST
NOV. 21	14	26	02.9	59.93 N.	152.20 W.	74	...	...	...	...	G	NOV. 21	04 A.M. AST
NOV. 23	05	33	18.0	56.61 N.	152.75 W.	33N	4.7	4.0	...	...	G	NOV. 22	07 P.M. AST
NOV. 23	16	55	20.4	52.20 N.	171.55 W.	53	5.5	5.5	...	...	G	NOV. 23	05 A.M. BST
NOV. 24	03	23	46.8	63.47 N.	147.68 W.	84	...	...	...	...	G	NOV. 23	05 P.M. AST
NOV. 24	21	01	40.8	63.34 N.	151.39 W.	33N	...	...	3.6M	...	G	NOV. 24	11 A.M. AST
NOV. 25	09	57	23.3	59.95 N.	147.44 W.	33N	...	...	3.5M	...	G	NOV. 24	11 P.M. AST
NOV. 25	23	37	13.2	51.86 N.	179.99 W.	88	5.0	...	...	...	G	NOV. 25	12 P.M. BST
NOV. 26	05	06	49.8	65.49 N.	153.46 W.	29	...	...	...	...	G	NOV. 25	07 P.M. AST
NOV. 26	16	17	48.1	62.28 N.	150.75 W.	16	...	...	3.2M	...	G	NOV. 26	06 A.M. AST
NOV. 27	10	46	43.8	51.34 N.	166.34 W.	33N	5.0	4.7	...	...	G	NOV. 26	11 P.M. BST
NOV. 27	15	05	06.8	58.56 N.	155.38 W.	116	4.9	...	...	V	G	NOV. 27	05 A.M. AST
NOV. 27	16	51	08.5	65.95 N.	155.40 W.	30	...	...	3.9M	...	G	NOV. 27	06 A.M. AST
NOV. 28	13	06	37.8	53.03 N.	175.00 W.	232	4.6	...	...	...	G	NOV. 28	02 A.M. BST
NOV. 28	20	55	12.8	64.80 N.	147.09 W.	15	...	...	...	...	G	NOV. 28	10 A.M. AST
NOV. 29	03	14	40.2	59.96 N.	147.31 W.	33N	...	...	...	...	G	NOV. 28	05 P.M. AST
DEC. 1	17	54	45.0	60.37 N.	152.73 W.	117	...	...	...	...	G	DEC. 1	07 A.M. AST
DEC. 6	12	49	44.1	51.62 N.	168.72 W.	33N	4.1	...	...	...	G	DEC. 6	01 A.M. BST
DEC. 7	17	01	06.8	51.15 N.	178.30 E.	44	4.4	...	...	...	G	DEC. 7	06 A.M. BST
DEC. 7	22	45	43.3	59.59 N.	146.17 W.	42	...	...	3.8M	...	G	DEC. 7	12 P.M. AST
DEC. 8	01	58	05.8	59.45 N.	151.36 W.	65	4.7	...	...	IV	G	DEC. 7	03 P.M. AST
DEC. 8	17	27	58.6	63.51 N.	147.58 W.	63	...	...	...	...	G	DEC. 8	07 A.M. AST
DEC. 10	09	01	02.2	60.76 N.	151.96 W.	87	...	...	...	...	G	DEC. 9	11 P.M. AST
DEC. 14	17	16	25.8	53.44 N.	164.35 W.	31	4.4	...	...	...	G	DEC. 14	06 A.M. BST
DEC. 15	01	29	22.6	61.37 N.	150.01 W.	38	...	...	3.0M	III	G	DEC. 14	03 P.M. AST
DEC. 15	03	22	33.1	64.28 N.	149.34 W.	33N	...	...	...	...	G	DEC. 14	05 P.M. AST
DEC. 15	16	28	01.6	62.12 N.	148.19 W.	55	...	...	...	...	G	DEC. 15	06 A.M. AST
DEC. 15	23	56	54.9	53.21 N.	172.93 E.	33N	4.3	3.8	...	...	G	DEC. 15	12 P.M. BST
DEC. 16	21	49	21.7	59.77 N.	153.45 W.	118	4.9	...	...	II	G	DEC. 16	11 A.M. AST
DEC. 17	11	32	24.4	52.23 N.	170.10 W.	44	5.0	5.1	...	...	G	DEC. 17	00 A.M. BST
DEC. 17	13	58	43.7	51.30 N.	176.27 W.	50	4.3	...	...	...	G	DEC. 17	02 A.M. BST
DEC. 17	15	43	20.7	63.51 N.	147.52 W.	80	...	...	...	...	G	DEC. 17	05 A.M. AST
DEC. 17	17	27	27.5	52.21 N.	170.02 W.	40	5.3	5.5	...	...	G	DEC. 17	06 A.M. BST
DEC. 18	00	58	11.7	57.61 N.	151.26 W.	29	4.7	...	4.5M	...	G	DEC. 17	02 P.M. AST
DEC. 18	05	07	18.0	59.97 N.	152.97 W.	134	...	...	...	...	G	DEC. 17	07 P.M. AST
DEC. 19	10	48	08.5	51.18 N.	176.28 W.	44	4.2	...	...	...	G	DEC. 18	11 P.M. BST
DEC. 19	10	52	38.9	51.19 N.	176.44 W.	53	5.1	...	...	...	G	DEC. 18	11 P.M. BST
DEC. 19	13	24	34.2	57.91 N.	150.24 W.	66	...	...	...	...	G	DEC. 19	03 A.M. AST
DEC. 19	20	31	22.7	51.34 N.	176.37 W.	54	4.6	...	...	...	G	DEC. 19	09 A.M. BST
DEC. 20	04	08	58.4	51.29 N.	176.54 W.	56	4.0	...	...	...	G	DEC. 19	05 P.M. BST
DEC. 20	06	10	44.0	51.32 N.	176.29 W.	53	4.1	...	...	...	G	DEC. 19	07 P.M. BST
DEC. 20	12	56	09.8	63.29 N.	150.45 W.	149	...	...	...	...	G	DEC. 20	02 A.M. AST
DEC. 25	01	44	17.9	54.46 N.	164.22 W.	121	4.0	...	...	...	G	DEC. 24	02 P.M. BST
DEC. 27	01	19	02.3	62.45 N.	150.61 W.	39	...	...	3.0M	...	G	DEC. 26	03 P.M. AST
DEC. 27	15	09	51.0	60.39 N.	153.70 W.	175	5.1	...	...	V	G	DEC. 27	05 A.M. AST
DEC. 28	01	45	55.4	65.77 N.	154.96 W.	33N	...	...	3.4M	...	G	DEC. 27	03 P.M. AST
DEC. 28	06	04	49.6	61.51 N.	150.07 W.	41	...	...	...	...	G	DEC. 27	08 P.M. AST
DEC. 28	07	02	06.0	59.49 N.	152.34 W.	111	...	...	...	...	G	DEC. 27	09 P.M. AST
DEC. 28	18	49	55.9	51.36 N.	173.30 W.	33N	4.5	...	...	...	G	DEC. 28	07 A.M. BST
DEC. 29	06	53	08.9	59.60 N.	144.77 W.	33N	...	...	3.2M	...	G	DEC. 28	08 P.M. AST
DEC. 29	21	48	16.7	61.65 N.	146.38 W.	57	4.3	...	...	III	G	DEC. 29	11 A.M. AST
DEC. 29	22	18	39.0	61.86 N.	147.13 W.	33N	...	...	3.0M	...	G	DEC. 29	12 P.M. AST
DEC. 30	09	02	44.1	52.15 N.	169.59 W.	38	5.0	4.5	...	...	G	DEC. 29	10 P.M. BST
DEC. 30	14	56	16.2	51.93 N.	172.85 W.	33N	4.8	...	...	...	G	DEC. 30	03 A.M. BST
ARIZONA													
OCT. 21	02	55	13.4	34.63 N.	112.48 W.	10	...	...	2.5G	V	G	OCT. 20	07 P.M. MST

Table 1.–*Summary of U.S. earthquakes for October-December 1977*–Continued

Date (1977)	Origin time (UTC) hr	min	s	Lat	Long	Depth (km)	Magnitude mb	MS	ML or mbLg	Maximum intensity	Hypocenter source	Local time Date	Hour
ARKANSAS													
NOV. 26	04	18	17.0	34.52 N.	92.96 W.	5	...	...	3.1S	IV	G	NOV. 25	10 P.M. CST
CALIFORNIA													
OCT. 1	00	23	44.1	34.42 N.	118.42 W.	5	...	...	3.0P	...	P	SEP. 30	04 P.M. PST
OCT. 1	10	07	40.6	35.27 N.	119.35 W.	5	...	...	3.2P	...	P	OCT. 1	02 A.M. PST
OCT. 4	06	39	39.6	40.26 N.	121.27 W.	5	...	...	3.8B	V	B	OCT. 3	10 P.M. PST
OCT. 4	23	22	16.7	33.83 N.	117.05 W.	10	...	...	3.1P	...	P	OCT. 4	03 P.M. PST
OCT. 6	08	16	03.4	34.02 N.	118.18 W.	14	...	...	3.3P	III	P	OCT. 6	00 A.M. PST
OCT. 6	11	50	58.1	34.88 N.	120.32 W.	4	...	...	2.9P	II	P	OCT. 6	03 A.M. PST
OCT. 6	11	52	04.7	34.88 N.	120.30 W.	4	...	...	2.5P	II	P	OCT. 6	03 A.M. PST
OCT. 6	11	56	50.2	34.87 N.	120.37 W.	3	...	...	2.8P	II	P	OCT. 6	03 A.M. PST
OCT. 8	00	32	59.1	40.01 N.	122.98 W.	11	3.7	...	3.1B	...	B	OCT. 7	04 P.M. PST
OCT. 9	03	26	26.3	34.42 N.	118.42 W.	10	...	...	3.3P	III	P	OCT. 8	07 P.M. PST
OCT. 10	12	38	00.6	33.57 N.	118.08 W.	5	...	...	3.0P	...	P	OCT. 10	04 A.M. PST
OCT. 10	19	26	04.9	38.02 N.	118.75 W.	6	...	...	4.0B	...	B	OCT. 10	11 A.M. PST
OCT. 13	08	18	11.0	33.22 N.	115.63 W.	4	...	...	3.4P	...	P	OCT. 13	00 A.M. PST
OCT. 13	16	10	27.7	37.47 N.	121.03 W.	10	...	...	3.7B	V	B	OCT. 13	08 A.M. PST
OCT. 18	10	08	18.9	36.59 N.	121.25 W.	6	5.0	...	3.5B	...	B	OCT. 18	02 A.M. PST
OCT. 18	19	10	13.4	34.23 N.	119.65 W.	5	...	...	3.0P	...	P	OCT. 18	11 A.M. PST
OCT. 19	06	56	07.7	32.90 N.	115.50 W.	5	...	...	2.8P	II	P	OCT. 18	10 P.M. PST
OCT. 19	11	46	08.3	38.36 N.	122.56 W.	10	...	...	3.3B	IV	B	OCT. 19	03 A.M. PST
OCT. 19	12	13	35.6	32.88 N.	115.50 W.	6	...	...	2.9P	III	P	OCT. 19	04 A.M. PST
OCT. 20	08	17	40.5	32.88 N.	115.50 W.	5	...	...	3.2P	II	P	OCT. 20	00 A.M. PST
OCT. 20	10	29	35.9	32.88 N.	115.50 W.	5	...	...	4.0P	II	P	OCT. 20	02 A.M. PST
OCT. 20	19	06	16.5	32.88 N.	115.50 W.	4	...	...	3.8P	II	P	OCT. 20	11 A.M. PST
OCT. 20	20	14	00.6	33.73 N.	118.02 W.	5	...	...	2.7P	II	P	OCT. 20	12 P.M. PST
OCT. 20	20	22	22.9	32.90 N.	115.50 W.	5	...	...	3.9P	II	P	OCT. 20	12 P.M. PST
OCT. 21	00	9	39.1	32.90 N.	115.50 W.	6	...	...	3.4P	II	P	OCT. 20	04 P.M. PST
OCT. 21	06	12	36.2	32.90 N.	115.50 W.	6	3.7	...	4.3P	VI	P	OCT. 20	10 P.M. PST
OCT. 21	13	24	24.2	32.90 N.	115.50 W.	5	...	...	4.2P	III	P	OCT. 21	05 A.M. PST
OCT. 21	18	10	58.3	32.88 N.	115.50 W.	5	...	...	3.0P	II	P	OCT. 21	10 A.M. PST
OCT. 22	04	59	17.3	34.38 N.	117.05 W.	2	...	...	3.7P	II	P	OCT. 21	08 P.M. PST
OCT. 22	09	05	59.4	32.88 N.	115.50 W.	5	...	...	3.0P	...	P	OCT. 22	01 A.M. PST
OCT. 22	18	30	42.2	32.90 N.	115.50 W.	6	...	...	4.0P	...	P	OCT. 22	10 A.M. PST
OCT. 24	20	42	19.7	32.82 N.	115.45 W.	8	...	...	3.0P	...	P	OCT. 24	12 P.M. PST
OCT. 24	20	44	17.7	32.80 N.	115.45 W.	7	...	...	3.0P	...	P	OCT. 24	12 P.M. PST
OCT. 26	11	02	53.9	32.90 N.	115.48 W.	6	...	...	3.0P	...	P	OCT. 26	03 A.M. PST
OCT. 28	19	32	25.4	32.87 N.	115.50 W.	6	...	...	3.1P	...	P	OCT. 28	11 A.M. PST
OCT. 28	21	24	52.4	32.87 N.	115.50 W.	16	...	...	3.9P	II	P	OCT. 28	01 P.M. PST
OCT. 28	21	31	36.6	32.90 N.	115.52 W.	5	...	...	3.0P	II	P	OCT. 28	01 P.M. PST
OCT. 28	23	44	29.3	35.33 N.	117.93 W.	5	...	...	3.1P	...	P	OCT. 28	03 P.M. PST
OCT. 29	00	41	55.6	32.88 N.	115.50 W.	6	...	...	3.1P	...	P	OCT. 28	04 P.M. PST
OCT. 30	05	30	13.3	32.88 N.	115.50 W.	4	4.7	...	4.0P	II	P	OCT. 29	09 P.M. PST
OCT. 30	06	13	32.9	32.88 N.	115.48 W.	4	...	...	3.2P	...	P	OCT. 29	10 P.M. PST
NOV. 1	04	06	43.4	37.71 N.	122.56 W.	2	...	...	3.3B	V	B	OCT. 31	08 P.M. PST
NOV. 2	15	30	25.1	33.52 N.	115.88 W.	5	...	...	3.6P	...	P	NOV. 2	07 A.M. PST
NOV. 3	17	08	42.2	36.46 N.	121.00 W.	2	...	...	3.1B	...	B	NOV. 3	09 A.M. PST
NOV. 4	02	55	32.0	40.32 N.	124.55 W.	30	...	...	3.6B	...	B	NOV. 3	06 P.M. PST
NOV. 4	15	12	53.0	36.58 N.	121.20 W.	5	...	...	3.4B	V	B	NOV. 4	07 A.M. PST
NOV. 8	10	52	27.2	33.88 N.	117.90 W.	7	...	...	3.4P	V	P	NOV. 8	02 A.M. PST
NOV. 10	02	35	24.1	36.10 N.	117.90 W.	5	...	...	3.6P	...	P	NOV. 9	06 P.M. PST
NOV. 10	20	24	42.2	39.43 N.	121.53 W.	4	...	...	2.7B	V	B	NOV. 10	12 P.M. PST
NOV. 13	16	25	19.7	32.83 N.	115.47 W.	5	...	...	3.2P	III	P	NOV. 13	08 A.M. PST
NOV. 14	00	11	35.8	32.83 N.	115.47 W.	5	...	...	3.9P	III	P	NOV. 13	04 P.M. PST
NOV. 14	00	33	31.0	32.82 N.	115.47 W.	4	...	...	3.1P	III	P	NOV. 13	04 P.M. PST
NOV. 14	02	05	47.9	32.82 N.	115.47 W.	5	5.0	...	4.2P	VI	P	NOV. 13	06 P.M. PST
NOV. 14	02	10	18.5	32.83 N.	115.47 W.	5	...	...	3.4P	III	P	NOV. 13	06 P.M. PST
NOV. 14	02	32	14.8	32.83 N.	115.47 W.	5	...	...	3.1P	III	P	NOV. 13	06 P.M. PST
NOV. 14	03	19	07.2	32.82 N.	115.47 W.	5	...	...	3.0P	III	P	NOV. 13	07 P.M. PST
NOV. 14	04	49	56.6	32.80 N.	115.47 W.	6	...	...	3.0P	III	P	NOV. 13	08 P.M. PST
NOV. 14	05	05	20.3	32.83 N.	115.47 W.	3	...	...	3.8P	III	P	NOV. 13	09 P.M. PST
NOV. 14	05	13	45.3	32.83 N.	115.47 W.	5	...	...	3.1P	III	P	NOV. 13	09 P.M. PST
NOV. 14	05	18	02.6	32.83 N.	115.47 W.	6	...	...	3.7P	III	P	NOV. 13	09 P.M. PST

Table 1.–*Summary of U.S. earthquakes for October-December 1977*–Continued

Date (1977)	Origin time (UTC) hr	min	s	Lat	Long	Depth (km)	Magnitude mb	MS	ML or mbLg	Maximum intensity	Hypocenter source	Local time Date	Hour
CALIFORNIA--Continued													
NOV. 14	05	23	36.5	32.83 N.	115.47 W.	4	...	...	3.8P	III	P	NOV. 13	09 P.M. PST
NOV. 14	05	30	40.8	32.83 N.	115.47 W.	7	...	...	3.3P	III	P	NOV. 13	09 P.M. PST
NOV. 14	05	36	55.4	32.83 N.	115.47 W.	5	...	...	4.1P	IV	P	NOV. 13	09 P.M. PST
NOV. 14	06	45	46.7	32.83 N.	115.45 W.	6	...	...	3.0P	...	P	NOV. 13	10 P.M. PST
NOV. 14	10	23	06.2	32.77 N.	115.47 W.	4	...	...	3.4P	III	P	NOV. 14	02 A.M. PST
NOV. 14	12	20	19.5	32.82 N.	115.45 W.	5	...	...	4.3P	IV	P	NOV. 14	04 A.M. PST
NOV. 14	16	10	33.6	32.82 N.	115.45 W.	6	...	...	3.2P	III	P	NOV. 14	08 A.M. PST
NOV. 14	16	18	53.3	32.82 N.	115.45 W.	6	...	...	3.2P	III	P	NOV. 14	08 A.M. PST
NOV. 15	18	56	44.7	35.38 N.	118.47 W.	5	...	...	3.0P	...	P	NOV. 15	10 A.M. PST
NOV. 15	19	13	16.9	32.83 N.	115.47 W.	5	...	...	3.4P	III	P	NOV. 15	11 A.M. PST
NOV. 16	17	29	17.7	32.83 N.	115.47 W.	4	...	...	2.6P	II	P	NOV. 16	09 A.M. PST
NOV. 17	00	35	23.9	36.03 N.	117.80 W.	5	...	...	3.0P	...	P	NOV. 16	04 P.M. PST
NOV. 18	02	17	18.4	35.69 N.	121.04 W.	3	...	...	3.9B	V	B	NOV. 17	06 P.M. PST
NOV. 22	21	15	52.5	39.45 N.	123.26 W.	5	5.2	...	4.8B	VII	B	NOV. 22	01 P.M. PST
NOV. 23	13	53	53.8	39.45 N.	123.29 W.	3	4.0	...	3.4B	IV	B	NOV. 23	05 A.M. PST
NOV. 23	15	27	14.4	39.50 N.	123.30 W.	5	...	...	3.6B	IV	B	NOV. 23	07 A.M. PST
NOV. 23	15	29	13.3	39.50 N.	123.30 W.	5	...	...	3.3B	IV	B	NOV. 23	07 A.M. PST
NOV. 24	01	53	24.0	33.70 N.	116.83 W.	5	...	...	3.1P	...	P	NOV. 23	05 P.M. PST
NOV. 25	15	32	03.5	33.78 N.	116.00 W.	5	...	...	3.1P	...	P	NOV. 25	07 A.M. PST
NOV. 25	21	56	58.4	34.30 N.	116.33 W.	5	...	...	3.2P	...	P	NOV. 25	01 P.M. PST
NOV. 26	04	31	56.8	37.17 N.	121.64 W.	5	...	...	3.4B	...	B	NOV. 25	08 P.M. PST
NOV. 28	18	57	45.4	33.43 N.	116.40 W.	9	...	...	3.1P	...	P	NOV. 28	10 A.M. PST
NOV. 29	16	42	02.4	35.96 N.	120.49 W.	11	3.6	...	3.7B	V	B	NOV. 29	08 A.M. PST
DEC. 3	06	54	59.6	34.07 N.	118.40 W.	7	...	...	2.2P	II	P	DEC. 2	10 P.M. PST
DEC. 7	15	40	59.2	33.78 N.	118.08 W.	6	...	...	2.7P	II	P	DEC. 7	07 A.M. PST
DEC. 8	03	36	25.1	36.03 N.	117.88 W.	5	...	...	3.0P	...	P	DEC. 7	07 P.M. PST
DEC. 9	02	26	54.5	37.71 N.	122.62 W.	4	...	...	2.9B	II	B	DEC. 8	06 P.M. PDT
DEC. 12	01	11	46.1	37.33 N.	121.70 W.	7	...	...	3.5B	III	B	DEC. 11	05 P.M. PST
DEC. 12	13	20	02.6	36.03 N.	117.42 W.	6	...	...	3.0P	...	P	DEC. 12	05 A.M. PST
DEC. 15	11	15	29.0	36.58 N.	121.23 W.	6	3.6	...	4.2B	VI	B	DEC. 15	03 A.M. PST
DEC. 16	10	41	48.2	35.97 N.	120.49 W.	11	3.5	...	3.2B	...	B	DEC. 16	02 A.M. PST
DEC. 17	14	27	46.5	33.48 N.	116.60 W.	6	...	...	3.0P	...	P	DEC. 17	06 A.M. PST
DEC. 20	13	15	13.9	34.03 N.	118.20 W.	6	...	...	2.8P	V	P	DEC. 20	05 A.M. PST
DEC. 26	18	36	08.4	34.00 N.	116.85 W.	6	4.3	...	3.3P	...	P	DEC. 26	10 A.M. PST
DEC. 26	19	37	19.0	40.36 N.	124.74 W.	30	...	...	3.3B	...	B	DEC. 26	11 A.M. PST
DEC. 27	06	07	56.2	33.91 N.	118.51 W.	11	...	...	2.7P	II	P	DEC. 26	10 P.M. PST
DEC. 28	02	59	37.3	35.82 N.	120.33 W.	2	...	...	3.5B	V	B	DEC. 27	06 P.M. PST
DEC. 29	07	19	50.7	33.27 N.	116.00 W.	5	...	...	3.0P	...	P	DEC. 28	11 P.M. PST
DEC. 29	14	09	16.7	36.86 N.	120.04 W.	8	...	...	3.3B	II	B	DEC. 29	06 A.M. PST
CALIFORNIA--OFF THE COAST													
OCT. 10	04	04	42.7	40.43 N.	125.72 W.	20	...	...	3.3B	...	B	OCT. 9	08 P.M. PST
NOV. 10	01	28	02.2	40.40 N.	125.33 W.	12	...	...	3.2B	...	B	NOV. 9	05 P.M. PST
DEC. 30	07	24	24.5	40.74 N.	128.32 W.	15	...	...	4.1B	...	G	DEC. 29	11 P.M. PST
COLORADO													
NOV. 3	05	34		LARIMER COUNTY		.	...	...	2.0G	II	.	NOV. 2	10 P.M. MST
HAWAII													
OCT. 4	10	41	03.5	19.34 N.	155.12 W.	0	...	...	3.0H	...	H	OCT. 4	00 A.M. HST
OCT. 6	03	31	20.2	19.42 N.	155.30 W.	16	...	...	3.4H	IV	H	OCT. 5	05 P.M. HST
OCT. 10	00	38	51.9	19.39 N.	155.25 W.	25	...	...	4.0H	...	H	OCT. 9	02 P.M. HST
OCT. 10	09	23	58.7	19.37 N.	155.09 W.	8	...	...	3.1H	...	H	OCT. 9	11 P.M. HST
OCT. 13	04	57	41.5	19.45 N.	155.78 W.	11	...	...	3.4H	...	H	OCT. 12	06 P.M. HST
OCT. 15	22	02	31.8	18.83 N.	155.16 W.	16	...	...	3.4H	...	H	OCT. 15	12 P.M. HST
OCT. 26	11	11	42.5	18.88 N.	155.01 W.	14	...	...	3.5H	...	H	OCT. 26	01 A.M. HST
OCT. 28	14	28	25.7	19.31 N.	155.27 W.	9	...	...	3.2H	...	H	OCT. 28	04 A.M. HST
OCT. 28	23	18	22.8	19.43 N.	154.90 W.	9	...	...	3.0H	...	H	OCT. 28	01 P.M. HST
OCT. 30	20	35	31.6	19.33 N.	155.12 W.	9	...	...	3.1H	...	H	OCT. 30	10 A.M. HST
OCT. 31	12	21	46.1	19.31 N.	155.16 W.	9	...	...	3.0H	...	H	OCT. 31	02 A.M. HST

Table 1.–*Summary of U.S. earthquakes for October-December 1977*–Continued

Date (1977)	Origin time (UTC) hr	min	s	Lat	Long	Depth (km)	Magnitude mb	MS	ML or mbLg	Maximum intensity	Hypocenter source	Local time Date	Hour
HAWAII--Continued													
NOV. 1	23	38	23.3	19.35 N.	155.11 W.	10	...	...	3.8H	IV	H	NOV. 1	01 P.M. HST
NOV. 6	17	24	15.2	19.38 N.	155.42 W.	12	...	...	3.6H	IV	H	NOV. 6	07 A.M. HST
NOV. 17	22	34	12.6	19.16 N.	155.56 W.	38	...	...	3.6H	III	H	NOV. 17	12 P.M. HST
NOV. 19	05	16	17.1	19.33 N.	155.07 W.	8	...	...	3.2H	III	H	NOV. 18	07 P.M. HST
NOV. 21	13	37	32.0	19.47 N.	155.43 W.	12	...	...	3.0H	...	H	NOV. 21	03 A.M. HST
NOV. 22	19	38	12.7	19.46 N.	156.48 W.	17	...	...	3.1H	...	H	NOV. 22	09 A.M. HST
NOV. 22	23	06	46.5	19.30 N.	155.35 W.	10	...	...	3.3H	...	H	NOV. 22	01 P.M. HST
NOV. 23	03	14	09.9	19.33 N.	155.11 W.	10	...	...	3.2H	...	H	NOV. 22	05 P.M. HST
NOV. 25	18	54	51.4	19.35 N.	155.02 W.	8	...	...	3.5H	III	H	NOV. 25	08 A.M. HST
DEC. 3	04	30	55.7	19.33 N.	155.12 W.	9	...	...	3.1H	...	H	DEC. 2	06 P.M. HST
DEC. 5	08	25	37.8	19.35 N.	155.04 W.	9	...	...	3.2H	III	H	DEC. 4	10 P.M. HST
DEC. 6	05	39	02.3	19.37 N.	155.32 W.	31	...	...	3.2H	III	H	DEC. 5	07 P.M. HST
DEC. 6	19	17	22.4	19.95 N.	153.94 W.	10	...	...	3.2H	...	H	DEC. 6	09 A.M. HST
DEC. 14	18	19	32.7	19.32 N.	155.18 W.	12	...	...	3.2H	III	H	DEC. 14	08 A.M. HST
DEC. 18	19	04	56.4	19.40 N.	155.47 W.	11	...	...	3.0H	...	H	DEC. 18	09 A.M. HST
DEC. 19	19	35	01.6	19.33 N.	155.22 W.	10	...	...	3.2H	III	H	DEC. 19	09 A.M. HST
DEC. 22	08	25	55.1	19.33 N.	155.23 W.	10	...	...	3.6H	III	H	DEC. 21	10 P.M. HST
DEC. 27	13	57	50.6	19.33 N.	154.93 W.	40	...	...	3.5H	...	H	DEC. 27	03 A.M. HST
IDAHO													
NOV. 27	09	25	55.1	44.58 N.	116.27 W.	5	4.2	...	4.5G	VI	G	NOV. 27	01 A.M. PST
MASSACHUSETTS													
DEC. 20	17	44	23.4	41.84 N.	70.70 W.	0	...	...	3.1J	V	J	DEC. 20	12 P.M. EST
MISSISSIPPI													
NOV. 4	11	21	07.0	33.83 N.	89.28 W.	5	...	...	3.4S	V	G	NOV. 4	05 A.M. CST
MONTANA													
OCT. 19	16	50	50.9	44.77 N.	111.81 W.	10	...	...	4.7G	VI	G	OCT. 19	09 A.M. MST
NOV. 8	11	10	32.4	46.07 N.	111.65 W.	5	...	...	3.2E	...	G	NOV. 8	04 A.M. MST
NOV. 9	12	43	27.5	46.09 N.	111.72 W.	5	...	...	3.4E	...	G	NOV. 9	05 A.M. MST
DEC. 2	22	14	00.2	45.78 N.	112.77 W.	17	...	...	3.3E	...	G	DEC. 2	03 P.M. MST
NEVADA													
OCT. 26	14	15	00.1	37.01 N.	116.02 W.	0	4.4	...	4.5B	...	A	OCT. 26	06 A.M. PST
NOV. 1	18	06	00.1	37.19 N.	116.21 W.	0	4.7	...	4.1B	...	A	NOV. 1	10 A.M. PST
NOV. 9	22	00	00.1	37.07 N.	116.05 W.	0	5.7	4.0	5.6B	...	A	NOV. 9	02 P.M. PST
NOV. 16	12	53	22.2	37.34 N.	115.30 W.	6	...	...	3.0G	...	G	NOV. 16	04 A.M. PST
NOV. 17	19	30	00.1	37.02 N.	116.02 W.	0	4.7	...	4.4B	...	A	NOV. 17	11 A.M. PST
NOV. 17	20	39	24.7	37.02 N.	116.02 W.	0	3.8	...	3.4G	...	G	NOV. 17	12 P.M. PST
DEC. 5	00	9	45.7	37.89 N.	114.67 W.	5	...	...	3.2G	...	G	DEC. 4	04 P.M. PST
DEC. 13	00	57	17.1	38.98 N.	116.58 W.	5	...	...	3.0G	...	G	DEC. 12	04 P.M. PST
DEC. 14	15	00	00.0	37.03 N.	115.96 W.	5	...	...	3.4G	...	G	DEC. 14	07 A.M. PST
DEC. 14	15	30	00.2	37.14 N.	116.09 W.	0	5.7	...	5.6B	...	A	DEC. 14	07 A.M. PST
NEW HAMPSHIRE													
DEC. 25	15	35	53.5	43.20 N.	71.69 W.	0	...	...	3.2J	VI	J	DEC. 25	10 A.M. EST
OREGON--OFF THE COAST													
OCT. 1	18	33	58.3	44.38 N.	129.26 W.	15	4.7	...	...	...	G	OCT. 1	10 A.M. PST
OCT. 11	03	50	49.2	43.87 N.	127.95 W.	15	4.8	...	...	...	G	OCT. 10	07 P.M. PST
NOV. 20	00	22	39.1	43.47 N.	126.90 W.	15	4.7	...	...	...	G	NOV. 19	04 P.M. PST
SOUTH CAROLINA													
DEC. 15	19	16	43.1	32.92 N.	80.22 W.	9	...	...	3.0V	V	G	DEC. 15	02 P.M. EST

Table 1.–*Summary of U.S. earthquakes for October-December 1977*–Continued

Date (1977)	Origin time (UTC) hr	min	s	Lat	Long	Depth (km)	Magnitude mb	MS	ML or mbLg	Maximum intensity	Hypocenter source	Local time Date	Hour
TEXAS													
NOV. 28	01	40	50.5	32.95 N.	100.84 W.	5	...	...	3.5G	...	G	NOV. 27	07 P.M. CST
UTAH													
OCT. 2	07	15	16.6	40.50 N.	110.48 W.	3	...	...	3.1G	...	G	OCT. 2	00 A.M. MST
OCT. 11	07	56	06.5	40.49 N.	110.49 W.	6	4.8	...	4.7G	V	G	OCT. 11	00 A.M. MST
OCT. 11	08	37	53.4	40.54 N.	110.49 W.	5	...	...	3.4G	...	G	OCT. 11	01 A.M. MST
NOV. 28	02	23	11.0	41.35 N.	111.70 W.	7	...	...	2.8U	V	U	NOV. 27	07 P.M. MST
VIRGINIA													
OCT. 23	07	51	41.7	36.97 N.	82.04 W.	5	...	...	2.8V	...	G	OCT. 23	02 A.M. EST
WASHINGTON													
OCT. 14	02	53	32.5	48.51 N.	122.15 W.	11	...	...	3.3G	II	W	OCT. 13	06 P.M. PST

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*

[Sources of the hypocenter and magnitudes: (A) U.S. Department of Energy; (B) University of California, Berkeley; (D) University of Montana, Missoula; (G) U.S. Geological Survey, National Earthquake Information Service; (H) U.S. Geological Survey, Hawaiian Volcano Observatory; (J) Weston Observatory, Massachusetts; (L) Lamont-Doherty Geological Observatory, Palisades, New York; (M) NOAA, Alaska Tsunami Warning Center, Palmer; (P) California Institute of Technology, Pasadena; (S) St. Louis University, St. Louis, Missouri; (T) University of Oklahoma, Leonard; (U) University of Utah, Salt Lake City; (V) Virginia Polytechnic Institute and State University, Blacksburg; (W) University of Washington, Seattle. Dates and origin times are listed in Universal Coordinated Time (UTC) giving the hour, minute, and second. Epicenters are shown in decimal degrees. Only earthquakes with intensity data and explosions are listed]

Alaska

3 October (G) Central Alaska
- Origin time: 13 31 16.4
- Epicenter: 65.15 N., 146.84 W.
- Depth: 33 km
- Magnitude: 3.3 ML(M)
- Intensity III: Fairbanks area.

16 October (G) Southern Alaska
- Origin time: 04 25 40.0
- Epicenter: 59.88 N., 152.55 W.
- Depth: 82 km
- Magnitude: 4.6 mb
- Intensity V: Homer.
- Intensity III: Diamond Ridge.

18 October (G) Kenai Peninsula, Alaska
- Origin time: 10 48 37.3
- Epicenter: 60.70 N., 150.79 W.
- Depth: Normal.
- Magnitude: 3.7 mb, 3.4 ML(M)
- Intensity II: Anchorage, Kenai.

Alaska--Continued

19 October (G) Southern Alaska
- Origin time: 02 16 02.6
- Epicenter: 62.88 N., 150.56 W.
- Depth: 102 km
- Magnitude: 5.0 mb
- Intensity III: From Mount McKinley National Park to Anchorage.

27 October (G) Western Alaska
- Origin time: 08 53 20.5
- Epicenter: 64.65 N., 164.97 W.
- Depth: Normal.
- Magnitude: None computed.
- Intensity II: Nome.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

Alaska--Continued

28 October (G) Kenai Peninsula, Alaska
Origin time: 08 53 34.5
Epicenter: 60.91 N., 149.72 W.
Depth: 26 km
Magnitude: 3.4 ML(M)
Intensity II: Anchorage.

4 November (G) Southern Alaska
Origin time: 01 22 26.5
Epicenter: 61.13 N., 150.30 W.
Depth: 42 km
Magnitude: None computed.
Intensity II: Anchorage area.

4 November (G) Andreanof Islands, Aleutian Islands
Origin time: 09 52 55.7
Epicenter: 51.66 N., 175.95 W.
Depth: Normal.
Magnitude: 5.7 mb, 6.7 MS, 6.6 MS(P), 6.9 MS(B)
Intensity VI: Adak (fallen plaster; heavy furniture moved), Atka (cracked chimneys).

4 November (G) Andreanof Islands, Aleutian Islands
Origin time: 18 07 31.3
Epicenter: 51.43 N., 175.56 W.
Depth: Normal.
Magnitude: 5.4 mb, 5.4 MS, 5.4 MS(B)
Intensity IV: Adak.

6 November (G) Southeastern Alaska
Origin time: 19 11 02.7
Epicenter: 62.10 N., 144.94 W.
Depth: Normal.
Magnitude: 3.3 ML(M)
Intensity II: Glenallen.

17 November (G) Central Alaska
Origin time: 03 33 56.0
Epicenter: 64.97 N., 147.91 W.
Depth: 16 km
Magnitude: 3.9 ML(M)
Intensity IV: College, Esker.
Intensity III: Fairbanks.

17 November (G) Central Alaska
Origin time: 05 00 09.6
Epicenter: 64.61 N., 149.54 W.
Depth: 25 km
Magnitude: 3.3 ML(M)
Intensity II: College.

17 November (G) Southern Alaska
Origin time: 12 27 06.3
Epicenter: 61.29 N., 149.40 W.
Depth: 39 km
Magnitude: None computed.
Intensity III: Eagle River.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

Alaska--Continued

20 November (G) Southern Alaska
Origin time: 18 53 57.8
Epicenter: 62.43 N., 150.66 W.
Depth: 79 km
Magnitude: 4.9 mb
Intensity V: Sutton.
Intensity IV: Cantwell, Talkeetna.
Intensity III: Palmer.

27 November (G) Alaska Peninsula
Origin time: 15 05 06.8
Epicenter: 58.56 N., 155.38 W.
Depth: 116 km
Magnitude: 4.9 mb
Intensity V: King Salmon, Port Lions.
Intensity IV: Homer.
Intensity II: Kodiak.

8 December (G) Kenai Peninsula, Alaska
Origin time: 01 58 05.8
Epicenter: 59.45 N., 151.36 W.
Depth: 65 km
Magnitude: 4.7 mb
Intensity IV: Homer.

15 December (G) Southern Alaska
Origin time: 01 29 22.6
Epicenter: 61.37 N., 150.01 W.
Depth: 38 km
Magnitude: 3.0 ML(M)
Intensity III: Anchorage.

16 December (G) Southern Alaska
Origin time: 21 49 21.7
Epicenter: 59.77 N., 153.45 W.
Depth: 118 km
Magnitude: 4.9 mb
Intensity II: Palmer.

27 December (G) Southern Alaska
Origin time: 15 09 51.0
Epicenter: 60.39 N., 153.70 W.
Depth: 175 km
Magnitude: 5.1 mb
Intensity V: Anchorage, Anchor Point, Chugiak, Clam Gulch, Cooper Landing, Eagle River, Homer, Hope, Moose Pass, Tyonek, Wasilla.
Intensity IV: Kenai, Seward, Sterling, Talkeetna, Valdez.
Intensity III: Kasilof, Kodiak Island.

29 December (G) Southern Alaska
Origin time: 21 48 16.7
Epicenter: 61.65 N., 146.38 W.
Depth: 57 km
Magnitude: 4.3 mb
Intensity III: Valdez.
Intensity II: Palmer-Wasilla area.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

Arizona

21 October (G) Western Arizona
Origin time: 02 55 13.4
Epicenter: 34.63 N., 112.48 W.
Depth: 10 km
Magnitude: 2.5 ML
Intensity V: Chino Valley (felt by many, frightened several, moderate earth noise heard from east-west direction).
Intensity IV: Prescott (press report).

14 November (P) Imperial Valley region
Origin time: 02 05 47.9

See California listing.

14 November (P) Imperial Valley region
Origin time: 12 20 19.5

See California listing.

Arkansas

26 November (G) Central Arkansas
Origin time: 04 18 17.0
Epicenter: 34.52 N., 92.96 W.
Depth: 5 km
Magnitude: 3.1 mbLg(S), 2.9 mbLg(T)
Intensity IV: Malvern (T).
Intensity III: Donaldson (T), Harp (T), Leola (T).

California

4 October (B) Northern California
Origin time: 06 39 39.6
Epicenter: 40.26 N., 121.27 W.
Depth: 5 km
Magnitude: 3.8 ML
Intensity V: Chester (many awakened from sleep; buildings trembled).
Intensity IV: Clear Creek.

6 October (P) Southern California
Origin time: 08 16 03.4
Epicenter: 34.02 N., 118.18 W.
Depth: 14 km
Magnitude: 3.3 ML
Intensity III: East Los Angeles and Montebello areas (press report).

6 October (P) Southern California
Origin time: 11 50 58.1
Epicenter: 34.88 N., 120.32 W.
Depth: 4 km
Magnitude: 2.9 ML
Intensity II: Santa Maria.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

6 October (P) Southern California
Origin time: 11 52 04.7
Epicenter: 34.88 N., 120.30 W.
Depth: 4 km
Magnitude: 2.5 ML
Intensity II: Santa Maria.

6 October (P) Southern California
Origin time: 11 56 50.2
Epicenter: 34.87 N., 120.37 W.
Depth: 3 km
Magnitude: 2.8 ML
Intensity II: Santa Maria.

9 October (P) Southern California
Origin time: 03 26 26.3
Epicenter: 34.42 N., 118.42 W.
Depth: 10 km
Magnitude: 3.3 ML
Intensity III: Newhall, Saugus.

13 October (B) Central California
Origin time: 16 10 27.7
Epicenter: 37.47 N., 121.03 W.
Depth: 10 km
Magnitude: 3.7 ML
Intensity V:
Modesto--Many people felt shock; a few were frightened; buildings trembled.
Patterson--Many felt shock; trees and bushes shaken.
Ripon--A few people frightened; windows, doors, dishes rattled; small objects shifted.
Riverbank--Several awakened and frightened; buildings trembled.
Turlock--A few people awakened and frightened; everything rattled.
Intensity IV: Waterford (press report).
Intensity III: Stockton (press report).
Intensity II: Fresno (press report), Keyes.

19 October (P) Imperial Valley region
Origin time: 06 56 07.7
Epicenter: 32.90 N., 115.50 W.
Depth: 5 km
Magnitude: 2.8 ML
Intensity II: Brawley.

19 October (B) Northern California
Origin time: 11 46 08.3
Epicenter: 38.36 N., 122.56 W.
Depth: 10 km
Magnitude: 3.3 ML
Intensity IV: Napa (press report), Yountville (press report).
Intensity III: Bennett Valley (press report), Petaluma (press report), Rohnert Park (press report), Santa Rosa (B), Sonoma (B).

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

19 October (P) Imperial Valley region
Origin time: 12 13 35.6
Epicenter: 32.88 N., 115.50 W.
Depth: 6 km
Magnitude: 2.9 ML
Intensity III: Brawley.

20 October (P) Imperial Valley region
Origin time: 08 17 40.5
Epicenter: 32.88 N., 115.50 W.
Depth: 5 km
Magnitude: 3.2 ML
Intensity II: Brawley (P).

20 October (P) Imperial Valley region
Origin time: 10 29 35.9
Epicenter: 32.88 N., 115.50 W.
Depth: 5 km
Magnitude: 4.0 ML
Intensity II: Brawley (P).

20 October (P) Imperial Valley region
Origin time: 19 06 16.5
Epicenter: 32.88 N., 115.50 W.
Depth: 4 km
Magnitude: 3.8 ML
Intensity II: Brawley (P).

20 October (P) Southern California
Origin time: 20 14 00.6
Epicenter: 33.73 N., 118.02 W.
Depth: 5 km
Magnitude: 2.7 ML
Intensity II: Huntington Beach (P), Long Beach (P), Westminster (P).

20 October (P) Imperial Valley region
Origin time: 20 22 22.9
Epicenter: 32.90 N., 115.50 W.
Depth: 5 km
Magnitude: 3.9 ML
Intensity II: Brawley (P).

21 October (P) Imperial Valley region
Origin time: 00 09 39.1
Epicenter: 32.90 N., 115.50 W.
Depth: 6 km
Magnitude: 3.4 ML
Intensity II: Brawley (P).

21 October (P) Imperial Valley region
Origin time: 06 12 36.2
Epicenter: 32.90 N., 115.50 W.
Depth: 6 km
Magnitude: 3.7 mb(G), 4.3 ML
Intensity VI: Brawley (cracked plaster).
Intensity V: El Centro, Heber, Holtville (press report), Imperial (burglar alarms set off in many communities of Imperial Valley--press report).

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

21 October (P) Imperial Valley region
Origin time: 13 24 24.2
Epicenter: 32.90 N., 115.50 W.
Depth: 5 km
Magnitude: 4.2 ML
Intensity III: Brawley (press report).

21 October (P) Imperial Valley region
Origin time: 18 10 58.3
Epicenter: 32.88 N., 115.50 W.
Depth: 5 km
Magnitude: 3.0 ML
Intensity II: Brawley (P).

22 October (P) Southern California
Origin time: 04 59 17.3
Epicenter: 34.38 N., 117.05 W.
Depth: 2 km
Magnitude: 3.7 ML
Intensity II: Big Bear Lake (P), Lucerne Valley (P).

28 October (P) Imperial Valley region
Origin time: 21 24 52.4
Epicenter: 32.87 N., 115.50 W.
Depth: 16 km
Magnitude: 3.9 ML
Intensity II: Brawley (press report).

28 October (P) Imperial Valley region
Origin time: 21 31 36.6
Epicenter: 32.90 N., 115.52 W.
Depth: 5 km
Magnitude: 3.0 ML
Intensity II: Brawley (press report).

30 October (P) Imperial Valley region
Origin time: 05 30 13.3
Epicenter: 32.88 N., 115.50 W.
Depth: 4 km
Magnitude: 4.7 mb(G), 4.0 ML
Intensity II: El Centro (P).

1 November (B) Central California
Origin time: 04 06 43.4
Epicenter: 37.71 N., 122.56 W.
Depth: 2 km
Magnitude: 3.3 ML
Intensity V: San Francisco (buildings trembled).

4 November (B) Central California
Origin time: 15 12 53.0
Epicenter: 36.58 N., 121.20 W.
Depth: 5 km
Magnitude: 3.4 ML

This is the last and largest of five earthquakes that occurred in the Bitterwater and Bear Valley regions on November 3-4.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

Intensity V: Chualar, Greenfield, Pacific Grove, Soledad.
Intensity III: Bear Valley (press report).
Intensity II: Hollister (press report), King, Pinnacles National Monument (press report).

8 November (P) Southern California
Origin time: 10 52 27.2
Epicenter: 33.88 N., 117.90 W.
Depth: 7 km
Magnitude: 3.4 ML
Intensity V: Anaheim, La Mirada, Placentia.
Intensity IV: Fullerton, La Habra.

10 November (B) Northern California
Origin time: 20 24 42.2
Epicenter: 39.43 N., 121.53 W.
Depth: 4 km
Magnitude: 2.7 ML
Intensity V: Oroville, Palermo.

13 November (P) Imperial Valley region
Origin time: 16 25 19.7
Epicenter: 32.83 N., 115.47 W.
Depth: 5 km
Magnitude: 3.2 ML
Intensity III: El Centro (P).

14 November (P) Imperial Valley region
Origin time: 00 11 35.8
Epicenter: 32.83 N., 115.47 W.
Depth: 5 km
Magnitude: 3.9 ML
Intensity III: Imperial Valley region (P).

14 November (P) Imperial Valley region
Origin time: 00 33 31.0
Epicenter: 32.82 N., 115.47 W.
Depth: 4 km
Magnitude: 3.1 ML
Intensity III: El Centro (P).

14 November (P) Imperial Valley region
Origin time: 02 05 47.9
Epicenter: 32.82 N., 115.47 W.
Depth: 5 km
Magnitude: 5.0 mb(G), 4.2 ML
Intensity VI:
Arizona--Somerton (heavy furniture shifted; slight damage).
California--El Centro (slight damage to plaster walls in post office; small pieces fell; some windows broken), Imperial (cracks in interior plaster walls).
Intensity V:
Arizona--Yuma.
California--Calexico, El Cajon, Heber, Hultville, Jacumba, Winterhaven.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

Intensity IV:
California--Coachella Valley water district, Indio, Niland, Plaster City, Salton City.
Intensity III:
California--Riverside County, San Diego County.
Intensity II:
California--Bard, Palm Desert, Poway.

14 November (P) Imperial Valley region
Origin time: 02 10 18.5
Epicenter: 32.83 N., 115.47 W.
Depth: 5 km
Magnitude: 3.4 ML
Intensity III: El Centro (P).

14 November (P) Imperial Valley region
Origin time: 02 32 14.8
Epicenter: 32.83 N., 115.47 W.
Depth: 5 km
Magnitude: 3.1 ML
Intensity III: El Centro (P).

14 November (P) Imperial Valley region
Origin time: 03 19 07.2
Epicenter: 32.82 N., 115.47 W.
Depth: 5 km
Magnitude: 3.0 ML
Intensity III: El Centro (P).

14 November (P) Imperial Valley region
Origin time: 04 49 56.6
Epicenter: 32.80 N., 115.47 W.
Depth: 6 km
Magnitude: 3.0 ML
Intensity III: El Centro (P).

14 November (P) Imperial Valley region
Origin time: 05 05 20.3
Epicenter: 32.83 N., 115.47 W.
Depth: 3 km
Magnitude: 3.8 ML
Intensity III: Imperial Valley (P).

14 November (P) Imperial Valley region
Origin time: 05 13 45.3
Epicenter: 32.83 N., 115.47 W.
Depth: 5 km
Magnitude: 3.1 ML
Intensity III: El Centro (P).

14 November (P) Imperial Valley region
Origin time: 05 18 02.6
Epicenter: 32.83 N., 115.47 W.
Depth: 6 km
Magnitude: 3.7 ML
Intensity III: Imperial Valley (P).

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

14 November (P) Imperial Valley region
Origin time: 05 23 36.5
Epicenter: 32.83 N., 115.47 W.
Depth: 4 km
Magnitude: 3.8 ML
Intensity III: Imperial Valley (P).

14 November (P) Imperial Valley region
Origin time: 05 30 40.8
Epicenter: 32.83 N., 115.47 W.
Depth: 7 km
Magnitude: 3.3 ML
Intensity III: El Centro (P).

14 November (P) Imperial Valley region
Origin time: 05 36 55.4
Epicenter: 32.83 N., 115.47 W.
Depth: 5 km
Magnitude: 4.1 ML
Intensity IV: Imperial Valley, Calif. to Yuma, Ariz. (P).

14 November (P) Imperial Valley region
Origin time: 10 23 06.2
Epicenter: 32.77 N., 115.47 W.
Depth: 4 km
Magnitude: 3.4 ML
Intensity III: El Centro (P).

14 November (P) Imperial Valley region
Origin time: 12 20 19.5
Epicenter: 32.82 N., 115.45 W.
Depth: 5 km
Magnitude: 4.3 ML
Intensity IV: Imperial Valley, Calif. to Yuma, Ariz. (P).

14 November (P) Imperial Valley region
Origin time: 16 10 33.6
Epicenter: 32.82 N., 115.45 W.
Depth: 6 km
Magnitude: 3.2 ML
Intensity III: El Centro (P).

14 November (P) Imperial Valley region
Origin time: 16 18 53.3
Epicenter: 32.82 N., 115.45 W.
Depth: 6 km
Magnitude: 3.2 ML
Intensity III: El Centro (P).

14 November (P) Imperial Valley region
Origin time: 19 13 16.9
Epicenter: 32.83 N., 115.47 W.
Depth: 5 km
Magnitude: 3.4 ML
Intensity III: Imperial Valley (P).

16 November (P) Imperial Valley region
Origin time: 17 29 17.7
Epicenter: 32.83 N., 115.47 W.
Depth: 4 km
Magnitude: 2.6 ML
Intensity II: El Centro (P).

18 November (B) Central California
Origin time: 02 17 18.4
Epicenter: 35.69 N., 121.04 W.
Depth: 3 km
Magnitude: 3.9 ML
Intensity V: Bradley.
Intensity III: Cambria.
Intensity II: St. Helena.

22 November (B) Northern California
Origin time: 21 15 52.5
Epicenter: 39.45 N., 123.26 W.
Depth: 5 km
Magnitude: 5.2 mb(G), 4.8 ML

Simon and others (1978) described the geological setting of Willits as a city of 3,700 residents situated on the west edge of Little Lake Valley, a small alluvial basin near the head of the Eel River drainage. Franciscan assemblage rocks comprise the uplands surrounding the valley, and unconsolidated Quaternary deposits form the valley floor. Little Rock Valley is an area of active faulting, as evidenced by the en echelon cracks in the pavement in Willits and related right-lateral offsets in curbs and sidewalks at five localities (Simon and others, 1978). This faulting in Willits does not appear to be directly related to this earthquake as the earthquake is located about 9 km east of the town.

Most of the description of the damage at Willits, listed under intensity VII below was excerpted from Simon and others (1978). Figure 10 shows the geographical distribution of the damage in the Willits area.

The intensity data shown in figure 11 are the result of field interviews in the rural areas of Little Lake Valley, east of Willits, by K. L. Verosub, University of California, Davis, and evaluations by the U.S. Geological Survey. The results are included with the USGS canvass and listed below as effects at individual residences in Little Lake Valley.

This earthquake was felt over an area of approximately 15,000 sq km as shown in figure 12.

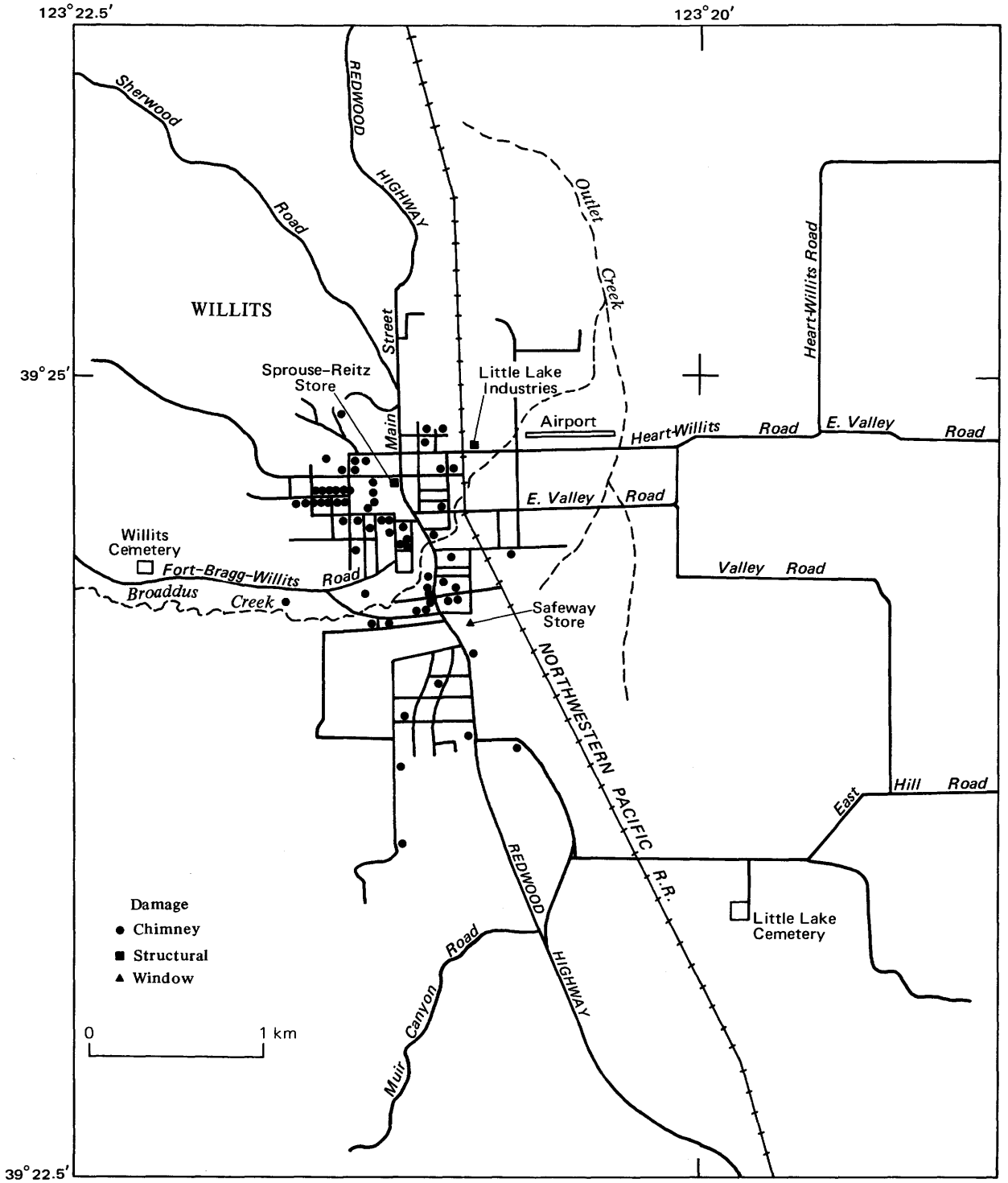

FIGURE 10.--Damage map of the community of Willits for the northern California earthquake of 22 November 1977, 22 15 52.5 UTC (Simon and others, 1978).

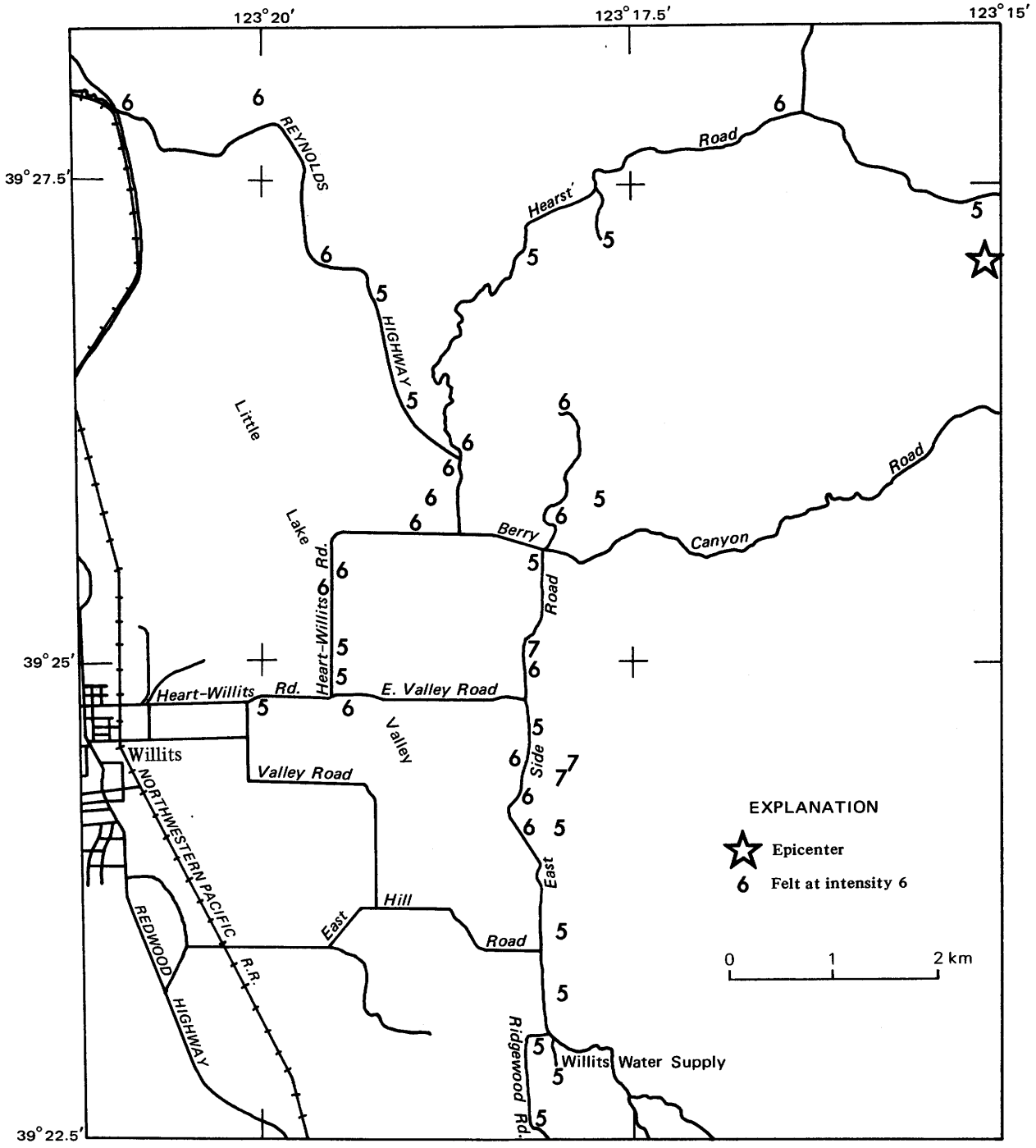

FIGURE 11.--Intensity map of the Little Lake Valley region for the northern California earthquake of 22 November 1977, 21 15 52.5 UTC (Simon and others, 1978). Arabic numerals are used to represent Modified Mercalli intensities at specific sites.

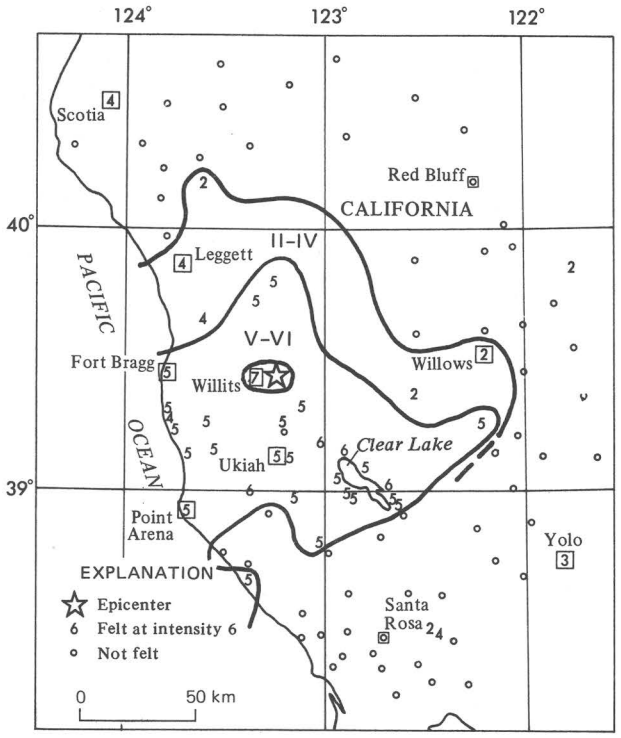

FIGURE 12.--Isoseismal map for the northern California earthquake of 22 November 1977, 21 15 52.5 UTC. Roman numerals represent Modified Mercalli intensities between isoseismals; Arabic numerals are used to represent these intensities at specific sites.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

Intensity VII:

Willits--Two buildings were reported to have suffered structural damage: the Sprouse-Reitz Store at 150 S. Main St. and a warehouse-type building that houses Little Lake Industries near the northeast corner of Hearst-Willits Road and the Northwestern Pacific Railroad tracks. The Sprouse-Reitz Store is in two old buildings, one brick and one concrete, joined lengthwise in an east-west direction, with flat roofs supported by reinforced concrete columns about 30 cm square; there are no north-south walls in this store. The two parts of this store responded differentially to the shaking as evidenced by cracks and offsets of as much as 12 mm along the join. Patches of new brick (ca. 1972) in the old brick wall also responded independently, as cracks outlined the patches and offsets of as much as 12 mm were formed. Near the building join, the concrete columns were cracked, and the ceiling of the concrete building had dropped as much as 50 mm. Evidence of some pounding between the two parts was suggested by damage to cabinets and fixtures fastened to the wall near the join. Aftershocks on the morning of November 23 had damaged the front plate-glass windows, by north-south distortion of the building and window frames.

The corner building, two buildings south of the Sprouse-Reitz Store, had numerous cracks in its south-facing stucco wall. Close inspection showed that most if not all of the cracks were pre-earthquake, but that some pounding had occurred during the earthquake. These cracks, which formed a rectangular pattern, probably represented former openings in the original wall that had been closed and plastered over within the past few years.

The Safeway Store lost one large pane of glass and also many bottled goods that were thrown from the shelves during the initial shock, but the store appeared sound otherwise.

Reports were that goods on east-west-oriented shelves were thrown down, but that goods on north-south-oriented shelves were not bothered. The Sprouse-Reitz Store lost items from its east-west shelves, and an auto parts store lost nothing from its predominantly north-south shelves. The Safeway Store's orientation indicated that most of the shelving was aligned northwest-southeast, with some other shelves along the walls in a northeast-southwest direction.

A drive-through inspection of the cemeteries revealed no toppled monuments; individual monuments were not examined for signs of having been rotated. On the west side of Main Street in the major residential district, damage appeared to have been restricted to brick chimneys on houses estimated to be at least 30 years old and more likely more than 50 years old. Damage to many chimneys was confined to the upper end, within the uppermost two or three courses of brick. Only a few chimneys were seen that had been reduced to the roofline (fig. 13); it is not known if these chimneys actually collapsed to the roofline or were razed to that point during the cleanup operation which began soon after the main shock. At least 10 of the damaged chimneys were broken midway

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

between the roofline and top, the upper part being offset 5° to 45° in a clockwise direction from the lower part; only 2 damaged chimneys were seen to be offset in a counterclockwise sense. The chimneys which suffered the most damage were old unreinforced brick and mortar construction. In contrast, newer chimneys, probably all less than 30 years old, appeared to be undamaged. Presumably, they contained reinforcing steel, but all were brick and mortar surrounding a fire-clay flue which itself may have acted as reinforcement. A tally by the City Building Inspector listed a total of 65 chimneys damaged by the November 22 shock. All of these defined a north-northwest-trending zone about 2.6 km long and 0.6 km wide, bounded on the east by the railroad and on the north by Willits Creek. Thirty-four of these chimneys were concentrated in the northern third of this zone; the remainder were scattered throughout the southern two-thirds. The highest concentration of damage was on Redwood Street, where 13 damaged chimneys were seen in a three-block area.

Only three slope failures were seen, all in steep roadcuts. These had a total volume estimated at less than 1 cu m. It is not known whether these failures were caused by the heavy rain which preceded the earthquake, by the earthquake, or by some other agent.

Car windshields were broken by falling bricks; plate-glass windows of Star Super and Safeway Stores were broken and groceries were thrown from shelves, forcing the stores to close for 3 hours to clean up. Safeway reported $1,000 worth of food and liquor lost. Three schools closed for the day. The high school had a few bricks dislodged over the front door and some interior plaster damaged. Waves (rippling) appeared on the ground. A few internal walls of older structures collapsed; one of the hardest hit homes was that on Redwood Avenue belonging to Judge Hathaway; an inside wall collapsed and the chimney of the fireplace fell apart, both outside and inside.

Little Lake Valley, east of Willits--Residences on East Side Road near East Valley Road listed below by owner or resident (fig. 11).

Coleman-Hatch--At this residence, about 0.7 km north of the Douglas and Turners residences listed below, the chimney

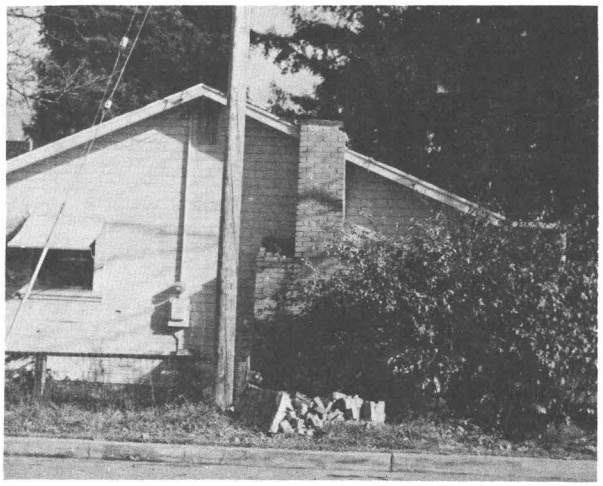

FIGURE 13.--Chimney damage in Willits from the northern California earthquake of 22 November 1977 (photo courtesy of R. E. Wallace, U.S. Geological Survey).

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

was cracked above the roofline; pictures fell from the walls; heavy furniture, including beds on the second floor, moved away from the wall approximately 15 cm; toilet tank lids flew up and off their bases; plaster was cracked; and glassware was broken.

Turners--A well pipe was reported broken, water sloshed out of their fish tank, and brackishness was noted in the water from a recently drilled well.

Intensity VI:

Boonville--Stone fences cracked, light furniture moved, standing vehicles rocked, trees and bushes shaken.

Clearlake Oaks--Foundations cracked, light furniture and small objects moved, buildings trembled, moving vehicles rocked moderately, water splashed onto sides of lake, many frightened.

Little Lake Valley, east of Willits--Owners or residents of the 16 properties listed below reported slight damage (fig. 11).

Bays, on the East Side Road--Minor structural damage was reported, wooden planks separated, and books and bric-a-brac were knocked from shelves.

Butin, just north of Morrison place--Plaster cracks were noted in the mortar around the fireplace, items fell from cupboards, and small objects tipped over.

Divine, located 0.8 km north of the Paetz property--Cracks were noted in the

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

plaster, fireplace, and ceilings; figurines broke; heavily loaded freezers on rollers turned partially away from the walls; and woodpiles in the barn collapsed.

Douglas, located adjacent to the Turners and also adjacent to the Fallen Leaf Nursery--Trees fell and a chandelier fell from the ceiling, breaking the dining room table.

Hauseknecht, East Side Road at Timberrose Ranch, between Divine and Patch properties--The barn cracked, and a statue fell and broke.

Kostanecki, on East Valley Road about halfway between the center of town and East Side Road--Structural damage to the barn and much glass breakage inside the house was reported.

Littlefield, Reynolds Highway, 5 km north of Hearst-Willits Road--A crack was reported in a kitchen wall, one corner of the bathroom cracked, and one ceramic figurine was broken.

Maxwell, on northern side of intersection of Berry Canyon and East Side Roads--A doorway spread in one room, tiles cracked in the bathroom shower, and pictures fell from the mantle. Better flow of water from a well was noted after the earthquake.

Morrison, East Side Road, about 2 km south of East Valley Road--A new crack had formed on the roof, the refrigerator and freezer doors were thrown open, and a cookie jar lid was found broken on the floor while the remainder of the cookie jar stayed on the shelf.

Nichols-Worth Ranch, on the Hearst-Willits Road northeast of town, also about halfway to the valley's eastern edge--Bookshelves fell, plaster cracked, water sloshed out of open containers, and wavelike motion was visible across the fields.

Paetz, on Reynolds Highway, near Hearst-Willits Road--Seams were pulled apart in the building, books were thrown across the room from bookshelves, heavy furniture was displaced several centimeters, and possible fissures appeared in the ground around the home. A recently drilled artesian well, which normally has abundant overflow, slowed dramatically 3 to 4 days before the earthquake.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

Patch, off Canyon Road--Some brickwork cracks in the chimney were reported, cement walls of the house were seen to move, pictures were knocked askew, some items fell from shelves, and waterbeds sloshed.

Rust and Masiuk, located adjacent to each other at the extreme northernmost end of Little Lake Valley and on Reynolds Highway--A cracked chimney occurred at a rental house on the Rust place, and cracks in the roof of the Masiuk house were noted.

Sherburn, located in the center of the valley northeast of the town center on Hearst-Willits Road--There were hairline cracks in one house wall; a change occurred in the hang on one door, which now sticks; and a radio was reported knocked from a shelf.

Turner, on Hearst-Willits Road just west of the Berry Canyon Road--Cracks were noted in the chimney, ceiling, and plastered walls; dresser drawers were thrown out; numerous items fell from shelves, tables, and the television; dishes were thrown out of cupboards; and pictures were knocked askew.

Williams, East side at the intersection of East Valley Road--A crack appeared in a brick retaining wall, one dish was broken, items on shelves were knocked over, and a bed on rollers moved approximately 15 cm from the wall.

Upper Lake--Interior walls split, plaster and dry-wall cracked, buildings creaked.

Witter Springs--Sidewalks cracked, hairline cracks in exterior walls, plaster cracked, small objects fell, hanging objects and doors swung violently north-south.

Intensity V:

Albion--Many people felt shock; a few frightened; trees and bushes shaken; buildings trembled; north-south motion.

Clearlake Highlands--Frightened some, standing vehicles rocked, trees and bushes shaken, buildings trembled, hanging objects swung.

Clearlake Park--Standing and moving vehicles rocked moderately, trees and bushes shaken moderately, several people frightened.

Cloverdale--Many felt shock, a few frightened; trees and bushes shaken, standing vehicles rocked, buildings trembled, water in small containers disturbed, small objects and light furniture shifted.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

Comptche--Many felt and frightened by shock; buildings trembled; windows, doors, dishes rattled. Pendulum clock did not stop as it has in previous earthquakes. Pendulum swings in an east-west direction.

Covelo--Many felt shock, a few frightened; buildings trembled, water in small containers disturbed, hanging objects and doors swung moderately east-west.

Dos Rios--Buildings trembled.

Elk--All felt the shock, buildings trembled, pictures displaced, water in small containers disturbed, hanging objects swung slightly.

Finley--Several felt shock, hanging objects and doors swung moderately east-west, small objects moved.

Fort Bragg--Many felt and frightened by shock, trees and bushes shaken moderately, standing vehicles rocked, buildings trembled, small objects and light furniture shifted, water in small containers disturbed, hanging objects and doors swung east-west, moderate earth noise heard.

Hopland--Several felt shock and frightened by it, buildings trembled.

Kelseyville--Many felt shock, several frightened; trees and bushes shaken, standing vehicles rocked, buildings trembled, water in small containers disturbed, hanging objects swung moderately north-south, small objects shifted, coats on hangers swung.

Lakeport--Felt by many; trees and bushes shaken; standing vehicles rocked moderately; sharp ground movement felt indoors as "bobbing in a small boat," which lasted about 12 seconds and seemed to come from the south; water in fish tank disturbed.

Leggett--A few people frightened; buildings creaked; windows, doors, dishes rattled.

Little Lake Valley residences east of Willits listed below by owner or resident (fig. 11).

Alpers, east of the Morrison property on Eastside Road--Pictures fell over on the piano, a chandelier swayed, but no breakage occurred. A roar was heard ahead of the quake.

Barber, Rocktree Valley Creek, 1.5 km east of Patton--Bells hung throughout the house began to ring, a globe suspended on fishing string began spinning around, water sloshed in beds and buckets, books fell from shelves, six 1-gal jugs of food fell from pantry shelves and broke. This all occurred in a 70-year-old wooden house built on a mud sill foundation. Mr. Barber said that although he never associated it with the earthquake, he had noticed a minor spring now present in the yard of the property which had not been there before the earthquake.

Bargsten, Hearst-Willits Road at intersection with East Valley Road--One small vase toppled.

Barton, Locust Knoll Ranch on Eastside Road, north of the Mann property--Everything moved, rocking chairs rocked and ceiling light fixtures swayed.

Burris, Reynolds Highway, 1 km south of Hanson--Pictures were tilted.

Cabe, Berry Canyon Road--Everything fell to the floor in a workshop, all the cupboards opened and the contents were thrown out, and figurines and whatnots were thrown off of shelves.

E. and W. Page, Berry Canyon Road--A heavy mirror swung on a wall, cups tilted over on a shelf, and a stereo speaker was knocked over. A spring on this property had increased flow after the earthquake, almost doubling production of water.

Eddy, located on Hearst Road in Rocktree Valley Canyon (This location is the farthest point in this study from downtown Willits and the nearest point to the instrumental epicenter.)--One vase fell from a high shelf in the kitchen of this home.

F. Page, Eastside Road south of East Valley Road--A few items were knocked from shelves in this mobile home unit, most from a bathroom medicine cabinet.

Hanson, Reynolds Highway just south of the Littlefield property--A few pictures were askew.

Kruse, Hearst-Willits Road in center of the valley--There was some breakage of small items that fell from shelves, and water in the fish tank splashed out.

Mann, Ridgewood Road, near the Willits water supply settling tank--Drawers slid out of a heavy chest of drawers on metal casters attached to the drawers, and the water heater fittings became loosened.

Patton, located along Rock Valley Creek--Shifting of pictures and jangling of pottery were reported, and beds moved.

Peters, south of the Mann property on Eastside Road--A few pictures were knocked askew.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

Props, Hearst-Willits Road, just east of the center of town--A woodburner vent was loosened and the CB radio was knocked from its shelf.

Shuster, Lucky 13 Ranch just west of Eastside Road, toward the valley floor, near a creek--A pool filter pipe was broken, but nothing was broken or displaced inside the house.

Swanson, Eastside Road north of Barton--In a ceramics shop, only seven pieces were broken, but several pictures on the wall were knocked askew. The earthquake was felt as a strong jolt.

Lucerne--A few felt shock and were frightened by it; windows, doors, dishes rattled.

Maxwell--Building trembled, plants swayed east-west.

Mendocino--Buildings trembled, small objects shifted, heavy furniture shifted.

Navarro--Many felt shock and were frightened by it; buildings trembled.

Point Arena--Several felt shock, buildings trembled, water in small containers disturbed, light fixtures swung east-west.

Potter Valley--All felt shock, some frightened by it; trees and bushes shaken, standing and moving vehicles rocked moderately, buildings trembled, water in small containers disturbed, hanging objects and doors swung moderately east-west, food knocked from shelves in market.

Redwood Valley--Many felt shock, a few frightened; trees and bushes shaken, moving vehicles rocked moderately, some small objects moved and some broken.

Stewarts Point--Trees and bushes shaken moderately, standing vehicles rocked, buildings creaked, water in small containers disturbed, small objects shifted, faint earth noise heard.

Talmage--Many felt shock, a few frightened; trees and bushes shaken moderately, standing and moving vehicles rocked, buildings trembled, water in small containers disturbed, hanging objects swung moderately north-south.

Ukiah--Many felt and frightened, trees and bushes shaken moderately, buildings trembled, water in small containers disturbed, hanging objects swung moderately east-west, small objects and light furniture moved.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

Intensity IV:
Branscomb--Felt by a few; windows, doors, dishes rattled.
Rutherford--Felt by a few; buildings creaked.
Scotia--Felt by a few; windows, doors, dishes rattled; buildings creaked.
Stonyford--Several felt shock; windows, dishes, doors rattled; buildings creaked; hanging objects swung.
Intensity III: Yolo (several felt earthquake).
Intensity II: Alderpoint, Richardson Springs, St. Helena (press report), Willows.

23 November (B) Northern California
Origin time: 13 53 53.8
Epicenter: 39.45 N., 123.29 W.
Depth: 3 km
Magnitude: 3.4 ML, 4.0 mb(G)
Intensity IV: Willits.

23 November (B) Northern California
Origin time: 15 27 14.4
Epicenter: 39.50 N., 123.30 W.
Depth: 5 km
Magnitude: 3.6 ML
Intensity IV: Willits.

23 November (B) Northern California
Origin time: 15 29 13.3
Epicenter: 39.50 N., 123.30 W.
Depth: 5 km
Magnitude: 3.3 ML
Intensity IV: Willits.

29 November (B) Central California
Origin time: 16 42 02.4
Epicenter: 35.96 N., 120.49 W.
Depth: 11 km
Magnitude: 3.6 mb(G), 3.7 ML
Intensity V: Bradley, San Miguel.
Intensity IV: Cholame.
Intensity III: Southern Monterey County, western Fresno County.
Intensity II: Atascadero (press report).

3 December (P) Southern California
Origin time: 06 54 59.6
Epicenter: 34.07 N., 118.40 W.
Depth: 7 km
Magnitude: 2.2 ML
Intensity II: Hollywood.

7 December (P) Southern California
Origin time: 15 40 59.2
Epicenter: 33.78 N., 118.08 W.
Depth: 6 km
Magnitude: 2.7 ML
Intensity II: Long Beach.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

9 December (B) Central California
Origin time: 02 26 54.5
Epicenter: 37.71 N., 122.62 W.
Depth: 4 km
Magnitude: 2.9 ML
Intensity III: Daly City, Sunset District of San Francisco.

12 December (B) Central California
Origin time: 01 11 46.1
Epicenter: 37.33 N., 121.70 W.
Depth: 7 km
Magnitude: 3.5 ML
Intensity III: Gilroy, San Jose.

15 December (B) Central California
Origin time: 11 15 29.0
Epicenter: 36.58 N., 121.23 W.
Depth: 6 km
Magnitude: 3.6 mb(G), 4.2 ML

This earthquake was felt over an area of approximately 5,500 sq km (fig. 14).

Intensity VI: Carmel Valley (plaster cracks in post office at Carmel Valley, ground cracks, small landslides at Carmel, cracks in highway--unconfirmed).
Intensity V: Big Sur, Capitola, Carmel, Chualar, Del Rey Oaks, Gonzales, Hollister, Los Gatos, Marina, Monterey, Moss Landing, Mount Hermon, Pacific Grove, Paicines, Salinas, San Juan Bautista, San Miguel, Santa Cruz, Seaside, Soledad, Soquel, Watsonville.
Intensity IV: Emmet (press report), Freedom, Pinnacles area (press report), San Benito County (press report), Santa Ana Valley (press report).
Intensity III: Aromas, Greenfield, Mount Hamilton.
Intensity II: Mission.

20 December (P) Southern California
Origin time: 13 15 13.9
Epicenter: 34.03 N., 118.20 W.
Depth: 6 km
Magnitude: 2.8 ML
Intensity V: Bell, Bell Gardens, Compton, Glendale, Hacienda Heights, Hancock, Hazard, La Palma, Long Beach, Los Angeles (downtown, south-central, and southeast areas--press report), Maywood, Monterey Park, North Edwards, Rowland Heights, South Gate, South Pasadena, Torrance.
Intensity IV: Calimesa, Llano, Murrieta, Pico Rivera, Vernon (press report).
Intensity II: El Toro, La Habra, Pacoima, Phelan.

27 December (P) Southern California
Origin time: 06 07 56.2

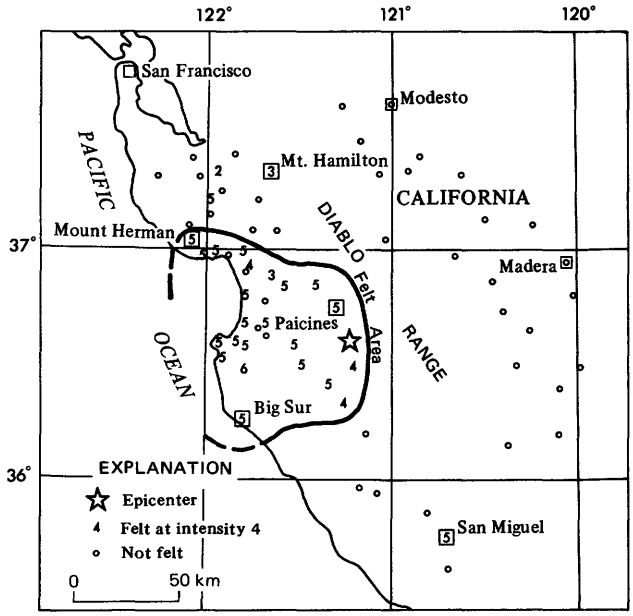

FIGURE 14.--Intensity map for the central California earthquake of 15 December 1977, 11 15 29.0 UTC. Arabic numerals are used to represent Modified Mercalli intensities at specific sites.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

California--Continued

Epicenter: 33.91 N., 118.51 W.
Depth: 11 km
Magnitude: 2.7 ML
Intensity II: Hawthorne.

28 December (B) Central California
Origin time: 02 59 37.3
Epicenter: 35.82 N., 120.33 W.
Depth: 2 km
Magnitude: 3.5 ML
Intensity V: Bradley, San Miguel.

29 December (B) Central California
Origin time: 14 09 16.7
Epicenter: 36.86 N., 120.04 W.
Depth: 8 km
Magnitude: 3.5 ML
Intensity II: Kerman (press report).

Colorado

3 November Northern Colorado
Origin time: 05 34
Epicenter: Not located.
Depth: None computed.
Magnitude: 2.0 ML(G)
Intensity II: Larimer County, Poudre River Canyon.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

Hawaii

The locations shown below that are followed by (H) designate intensity values assigned by the Hawaiian Volcano Observatory.

6 October (H) Island of Hawaii
Origin time: 03 31 20.2
Epicenter: 19.42 N., 155.30 W.
Depth: 16 km
Magnitude: 3.4 ML
Intensity IV: Volcano.

1 November (H) Island of Hawaii
Origin time: 23 38 23.3
Epicenter: 19.35 N., 155.11 W.
Depth: 10 km
Magnitude: 3.8 ML
Intensity IV: Hilo.
Intensity III: Papaikou.

6 November (H) Island of Hawaii
Origin time: 17 24 15.2
Epicenter: 19.38 N., 155.42 W.
Depth: 12 km
Magnitude: 3.6 ML
Intensity IV: Volcano.

17 November (H) Island of Hawaii
Origin time: 22 34 12.6
Epicenter: 19.16 N., 155.56 W.
Depth: 38 km
Magnitude: 3.6 ML
Intensity III: Hawaii Ocean View Estates, Pahala.
Intensity II: Hawaiian Volcano Observatory, Kona.

19 November (H) Island of Hawaii
Origin time: 05 16 17.1
Epicenter: 19.33 N., 155.07 W.
Depth: 8 km
Magnitude: 3.2 ML
Intensity III: Hilo.

25 November (H) Island of Hawaii
Origin time: 18 54 51.4
Epicenter: 19.35 N., 155.02 W.
Depth: 8 km
Magnitude: 3.5 ML
Intensity III: Kapaahu, Wahaula.
Intensity II: Hilo.

5 December (H) Island of Hawaii
Origin time: 08 25 37.8
Epicenter: 19.35 N., 155.04 W.
Depth: 9 km
Magnitude: 3.2 ML
Intensity III: Hilo, Mountain View.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

Hawaii--Continued

6 December (H) Island of Hawaii
Origin time: 05 39 02.3
Epicenter: 19.37 N., 155.32 W.
Depth: 31 km
Magnitude: 3.2 ML
Intensity III: Volcano.

14 December (H) Island of Hawaii
Origin time: 18 19 32.7
Epicenter: 19.32 N., 155.18 W.
Depth: 12 km
Magnitude: 3.2 ML
Intensity III: Volcano.

19 December (H) Island of Hawaii
Origin time: 19 35 01.6
Epicenter: 19.33 N., 155.22 W.
Depth: 10 km
Magnitude: 3.2 ML
Intensity III: Hilo.

22 December (H) Island of Hawaii
Origin time: 08 25 55.1
Epicenter: 19.33 N., 155.23 W.
Depth: 10 km
Magnitude: 3.6 ML
Intensity III: Hilo, Volcano.

Idaho

27 November (G) Western Idaho
Origin time: 09 25 55.1
Epicenter: 44.58 N., 116.27 W.
Depth: 5 km
Magnitude: 4.2 mb, 4.5 ML

This earthquake was felt over an area of approximately 24,000 sq km of Idaho and Oregon (fig. 15).

Intensity VI:
Idaho--Cascade (dry wall and foundation cracked, ceiling beams separated, well water and springs muddied).
Intensity V:
Idaho--Atlanta, Boise, Cambridge, Council, Donnelly, Emmett, Garden Valley, Homedale, Horse Shoe Bend, Indian Valley, McCall, Midvale, New Meadows, Ola, Payette, Sweet, Weiser.
Oregon--Ontario, Vale.
Intensity IV:
Idaho--Fruitland, Idaho City, Meridian, Pollock.
Intensity II: Riggins (press report), Yellow Pine.

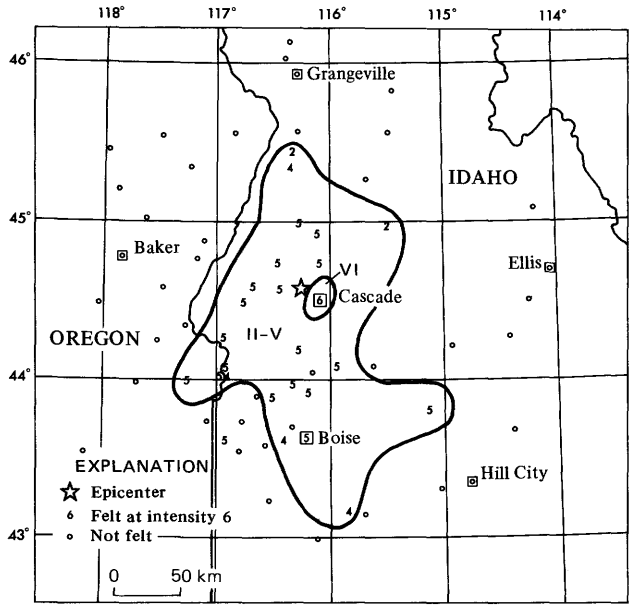

FIGURE 15.--Isoseismal map for the western Idaho earthquake of 27 November 1977, 09 25 55.1 UTC. Roman numerals represent Modified Mercalli intensities between isoseismals; Arabic numerals are used to represent these intensities at specific sites.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

Massachusetts

20 December (J) Eastern Massachusetts
Origin time: 17 44 23.4
Epicenter: 41.84 N., 70.70 W.
Depth: 0 km
Magnitude: 3.1 mbLg, 3.0 mbLg(L)

This earthquake was felt over an area of approximately 2,000 sq km of Massachusetts and Rhode Island (fig. 16).

Intensity V:
Massachusetts--Acushnet, Bridgewater (press report), Buzzards Bay, East Bridgewater, East Taunton, East Wareham, Fairhaven, Fall River, Halifax, Marion, Middleboro, North Carver, North Dartmouth, Onset, Plymouth, Raynham Center, Rochester, South Carver, Swansea, Taunton, Wareham, West Wareham.
Intensity IV:
Massachusetts--New Bedford (press report), Whitehorse Beach.
Rhode Island--Providence.
Intensity III:
Massachusetts--Dighton, Raynham, Segreganset, Sharon.
Intensity II:
Massachusetts--Chilmark, Foxboro.
Rhode Island--Conimicut.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

Mississippi

4 November (G) Northern Mississippi
Origin time: 11 21 07.0
Epicenter: 33.83 N., 89.28 W.
Depth: 5 km
Magnitude: 3.4 mbLg(S)
Intensity V: Vardaman.

Montana

19 October (G) Hebgen Lake region
Origin time: 16 50 50.9
Epicenter: 44.77 N., 111.81 W.
Depth: 10 km
Magnitude: 4.7 ML
Intensity VI:
West Yellowstone--Cracked plaster (unconfirmed); windows, doors, dishes rattled; buildings creaked and trembled; water in small containers slightly disturbed; small objects shifted.
Intensity V:
Clinton--A few people frightened, trees and bushes shaken slightly, standing and moving vehicles rocked slightly.
Fort Harrison--Trees and bushes shaken slightly.
Lima--Small objects shifted, hanging objects and doors swung moderately, and moderate earth noise heard at the Brenneman Ranch, 26 km due east of Lima. The bird refuge and building at Centennial Valley shook moderately at Lima.
Missoula--Slight tremor reported by a few. Trees and bushes shaken slightly, standing vehicles rocked.
Intensity IV:
Gardiner--Felt by a few; windows, doors, and dishes rattled.
Intensity III: Cardwell, Virginia City (felt by a few).

Nevada

26 October (A) Southern Nevada
Origin time: 14 15 00.076
Epicenter: 37.01 N., 116.02 W.
Depth: 0 km
Magnitude: 4.4 mb(G), 4.5 ML(B)

Nevada Test Site explosion "BOBSTAY" at 37°00'27.36" N., 116°01'00.14" W., surface elevation 1,125 m, depth of burial 381 m.

1 November (A) Southern Nevada
Origin time: 18 06 00.074

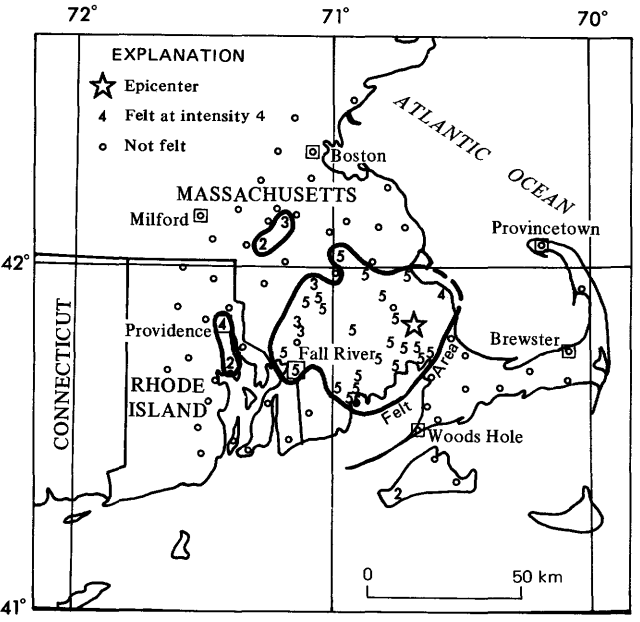

FIGURE 16.--Intensity map for the eastern Massachusetts earthquake of 20 December 1977, 17 44 23.4 UTC. Arabic numerals are used to represent Modified Mercalli intensities at specific sites.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

Nevada--Continued

Epicenter: 37.19 N., 116.21 W.
Depth: 0 km
Magnitude: 4.1 ML(B), 4.7 mb(G)

Nevada Test Site explosion "HYBLA GOLD" at 37°11'16.02" N., 116°12'46.66" W., surface elevation 2,266 m, depth of burial 385 m.

9 November (A) Southern Nevada
Origin time: 22 00 00.075
Epicenter: 37.07 N., 116.05 W.
Depth: 0 km
Magnitude: 5.7 mb(G), 4.0 MS(G), 5.6 ML(B)

Nevada Test Site explosion "SANDREEF" at 37°04'19.58" N., 116°03'00.04" W., surface elevation 1,248 m, depth of burial 701 m.

17 November (A) Southern Nevada
Origin time: 19 30 00.077
Epicenter: 37.02 N., 116.02 W.
Depth: 0 km
Magnitude: 4.7 mb(G), 4.4 ML(B)

Nevada Test Site explosion "SEAMOUNT" at 37°01'14.18" N., 116°01'30.28" W., surface elevation 1,213 m, depth of burial 372 m.

14 December (A) Southern Nevada
Origin time: 15 30 00.169

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

Nevada--Continued

Epicenter: 37.14 N., 116.09 W.
Depth: 0 km
Magnitude: 5.7 mb(G), 5.6 ML(B)

Nevada Test Site explosion "FARALLONES" at 37°08'09.13" N., 116°05'09.71" W., surface elevation 1,317 m, depth of burial 668 m.

New Hampshire

25 December (J) Southern New Hampshire
Origin time: 15 35 53.5
Epicenter: 43.20 N., 71.69 W.
Depth: 0 km
Magnitude: 3.2 mbLg(J), 3.1 mbLg(L)

This earthquake was felt over an area of approximately 2,800 sq km (fig. 17).

Intensity VI: Concord (plaster cracked in some homes, many frightened, a few windows cracked).
Intensity V: Andover, Bennington, Boscawen, Bradford, Canterbury, Contoocook, East Andover, Franklin, Gilmanton Iron Works, Loudon, New Durham, Salisbury, South Sutton, Warner, Weare, Wilmot Flat.
Intensity IV: Manchester.
Intensity III: Greenfield, New London, Tilton.
Intensity II: Francestown, Hillsboro, Marlow, South Lyndeboro.

Oregon

27 November (G) Western Idaho
Origin time: 09 25 55.1

See Idaho listing.

Rhode Island

20 December (J) Eastern Massachusetts
Origin time: 17 44 23.4

See Massachusetts listing.

South Carolina

15 December (G) Southeastern South Carolina
Origin time: 19 16 43.1
Epicenter: 32.92 N., 80.22 W.

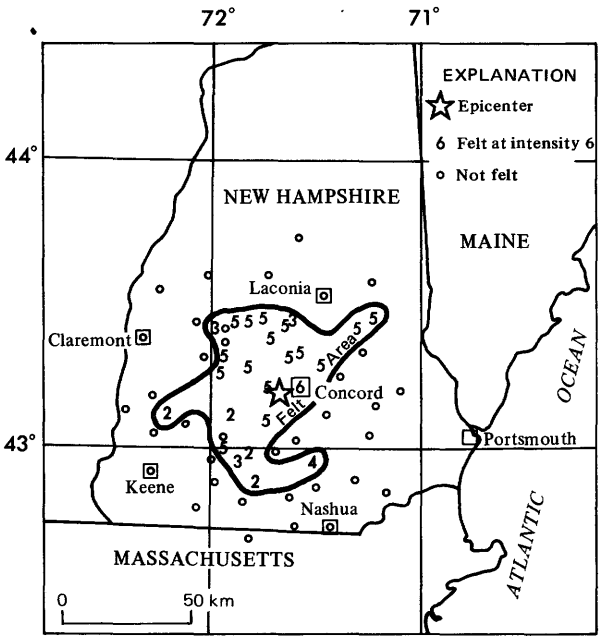

FIGURE 17.--Intensity map for the southern New Hampshire earthquake of 25 December 1977, 15 35 53.5 UTC. Arabic numerals are used to represent Modified Mercalli intensities at specific sites.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

South Carolina--Continued

Depth: 9 km
Magnitude: 3.0 mbLg(V)
Intensity V: Folly Beach, Mount Holly, Summerville, Wadmalaw Island.
Intensity IV: Charleston.
Intensity II: Charleston Airport.

Utah

11 October (G) Northeastern Utah
Origin time: 07 56 06.5
Epicenter: 40.49 N., 110.49 W.
Depth: 6 km
Magnitude: 4.8 mb, 4.7 ML
Intensity V:
Duchesne--Many awakened, a few frightened. West of Peterson Gulch, near Ranger station, about 19 km northwest of Altonah--Ranch caretaker "almost knocked out of bed;" one sharp jolt cracked a windowpane.
Intensity IV:
Altamont--Awakened a few.
Altonah, 3 1/2 km west--Awakened a few, everything rattled.

Table 2.–*Summary of macroseismic data for U.S. earthquakes, October-December 1977*–Continued

Utah--Continued

Bluebell--Awakened a few, everything rattled.
Intensity II:
East Grandaddy Mountain, about 6.5 km northwest of Peterson Gulch area--Small rockfalls noted at the mouth of nearby water-diversion tunnel by USGS personnel.

28 November (U) Northern Utah
Origin time: 02 23 11.0
Epicenter: 41.35 N., 111.70 W.
Depth: 7 km
Magnitude: 2.8 ML
Intensity V: Huntsville.
Intensity III: Ogden Canyon, Pineville Reservoir area, Southeast Ogden Bench area.

Washington

14 October (W) Northwestern Washington
Origin time: 02 53 32.5
Epicenter: 48.51 N., 122.15 W.
Depth: 11 km
Magnitude: 3.3 ML(G)
Intensity II: Sedro-Woolley area.

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