Geological Circular 84-3

OBSERVATIONS FROM THE EAST TEXAS SEISMIC NETWORK (June 1981-August 1982)

Wayne D. Pennington
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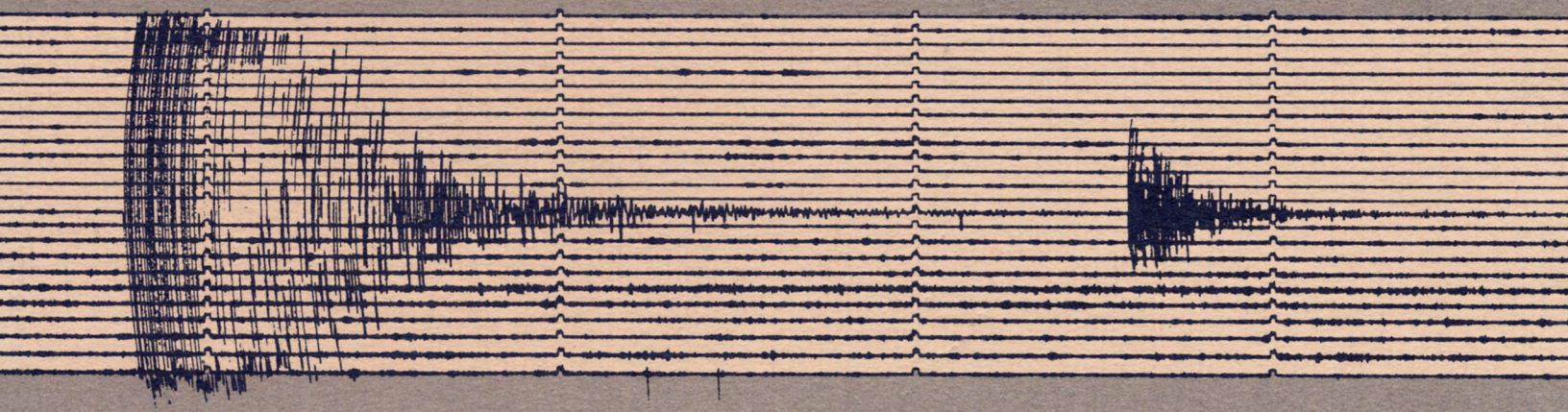

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Bureau of Economic Geology
W. L. Fisher, Director
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OBSERVATIONS FROM THE EAST TEXAS SEISMIC NETWORK (JUNE 1981 - AUGUST 1982)

by

Wayne D. Pennington*

and

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Cover: Seismogram of the Jacksonville earthquake and aftershock recorded at station FMTX of the East Texas Seismic Network.

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ABSTRACT

Several microearthquake recording stations were operated as a network in the East Texas Basin beginning in June 1981. At least six certain and two probable earthquakes as well as hundreds of events of undetermined origin were recorded through August 1982. Three of the earthquakes were felt by people in East Texas, including one earthquake and an aftershock at Jacksonville and one earthquake near Center. The Jacksonville earthquake and the Center earthquake were recorded at enough stations to be located instrumentally. Another aftershock near Jacksonville and an earthquake near the town of Mount Enterprise were apparently not felt but were located from instrumental recordings. Yet another Jacksonville aftershock was neither felt nor recorded at enough stations to be located but can be identified from the character of the waveform and relative arrival times at two stations. In addition, two other events were recorded at one station but were not felt and cannot be located; from the character of their waveforms, they appear to be earthquakes near the network.

These earthquakes cannot be assigned to any one fault in East Texas, and their depths are not well constrained. They occurred near the Mount Enterprise fault system along a 90-km segment and may represent activity along that fault system, along nearby secondary faults, or both.

Keywords: East Texas Basin, Mount Enterprise fault zone, earthquakes, microearthquakes, isoseismic maps, seismicity, seismotectonics, seismograph network.

INTRODUCTION

One criterion for safe isolation of nuclear wastes in geologic formations is a low probability of earthquake occurrence near enough to the storage site to cause damage. Earthquakes have occurred in areas of the East Texas Basin in which salt-dome repositories have been considered. In particular, probable earthquakes in 1891 near Rusk, in 1932 near Wortham, in 1957 near Mount Enterprise, and in 1964 near Hemphill call into question the seismic stability of the region.

To determine reliable earthquake locations and to estimate the frequency of earthquake occurrence, a seismic monitoring system, called the East Texas Seismic Network, was established in East Texas. During the first stage of monitoring, a single-channel, smoked-paper seismograph was installed near Rusk on February 5, 1980, by Law Engineering and Testing Company and the Bureau of Economic Geology. An electronic filter setting was changed on March 24, 1980, and most of the usable data were collected after that date. Many small impulsive events of undetermined origin were recorded; observations through April 1981 were summarized in an earlier report (Pennington and others, 1981).

Because a number of events, some of which may have been microearthquakes, were recorded by the single smoked-paper station, additional stations were installed. For this second stage of monitoring, a three-station, telemetered array with a central recording site was added on June 27, 1981, and other portable units were occasionally deployed. This report describes the operation of the complete network (the array and portable stations) and observations made from the array-installation date through August 30, 1982. For completeness, data are also presented concerning an earthquake on June 8, 1981 (June 9 Universal Coordinated Time [UTC]) near the town of Center, which was recorded by the smoked-paper unit and a number of regional seismograph stations, but which occurred just before installation of the telemetered array.

DESCRIPTION OF INSTRUMENTS AND SEISMIC NETWORK

Most of the data described in this report were obtained from the three-station telemetered array. Data were also obtained from the original single-channel smoked-paper recorder and other recorders deployed to complement the telemetered array and to provide coverage when individual telemetered stations were not operating. In addition, regional seismograph stations in Texas and neighboring states recorded two of the earthquakes reported here, and arrival times of earthquakes at those stations were used to help locate the East Texas earthquakes. Figure 1 (opposite) and table 1 (p. 17) give the locations of the stations used.

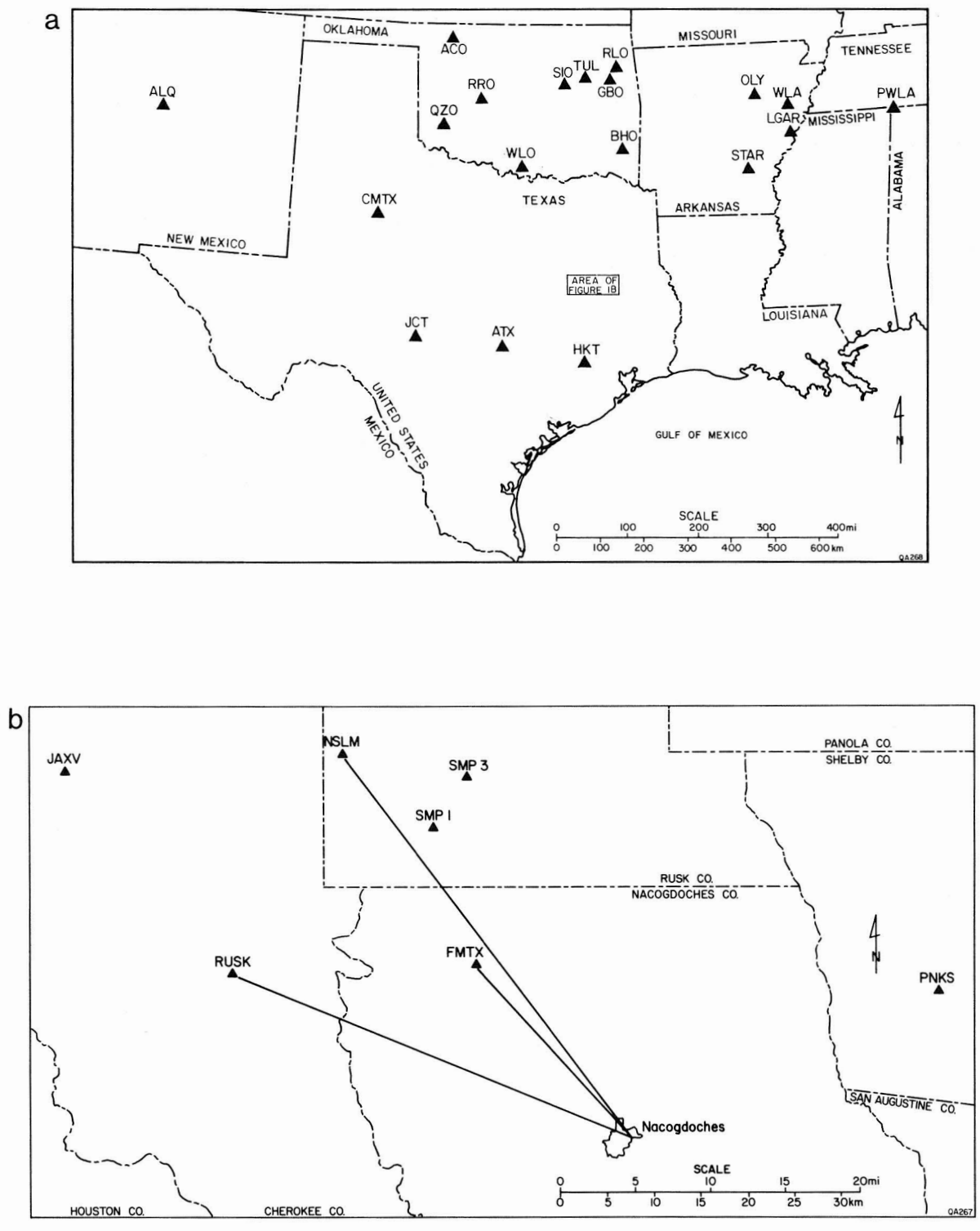


Figure 1. Locations of seismograph stations mentioned in this report. (a) Map of Texas and adjoining regions. Seismograph stations used in determining hypocentral locations in this report are indicated by a triangle and a station code. Station codes and geographic coordinates are given in table 1. (b) Map of area of East Texas shown by outline in (a). Stations of the East Texas Seismic Network are shown; telemetry paths are indicated by lines. Stations PNKS (Pinkston Dam) and JAXV (Jacksonville) were temporary sites and recorded no events discussed in this report. Names and coordinates of other stations in figure are given in table 1.

The single-channel station (SMP1) deployed in 1980 consisted of a 1-Hz vertical geophone (buried to reduce wind noise) and a Sprengnether MEQ-800 portable drum-recording seismograph. Records were changed every other day, and clock corrections were made at those times (to within 0.1 second) by WWV radio receiver. The station operated with a peak magnification of about 35,000 times at 10 Hz; sensitivity dropped off sharply at higher and lower frequencies (fig. 2). The sensitivity of the other smoked-paper installation (SMP3), operated at various times, was somewhat lower, and the gain and filter settings varied as local noise sources varied.

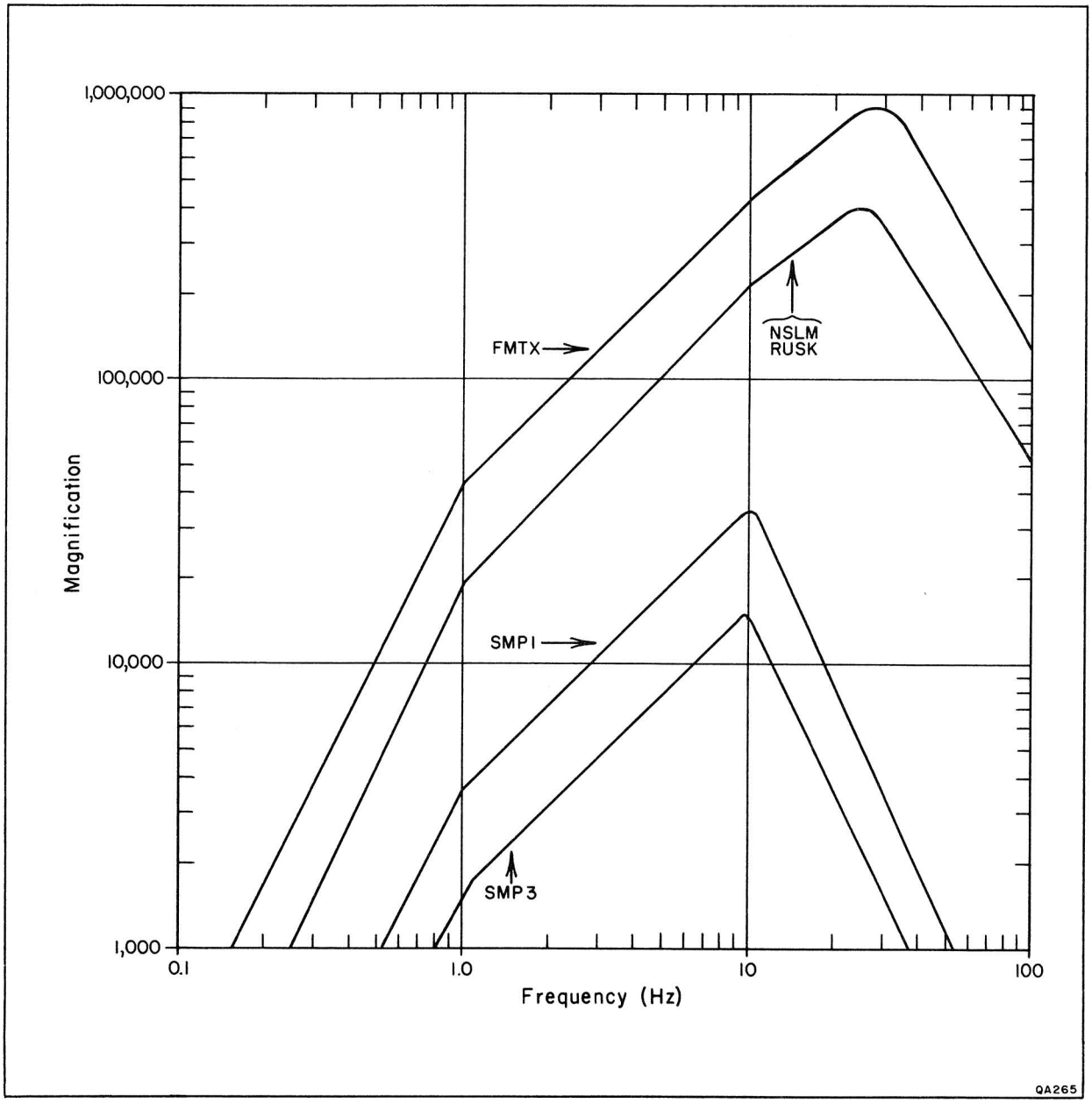


Figure 2. Displacement-magnification curves for stations of the East Texas Seismic Network. Stations FMTX, NSLM, and RUSK were telemetry sites; SMP1 and SMP3 were smoked-paper units.

The telemetry network consisted of three stations using radio links to a common recording site (fig. 3). At each remote site, ground motion was detected by a 1-Hz vertical geophone (Mark Products L-4C). The signals were amplified by a pre-amplifier and converted to a voltage-dependent audio frequency by a voltage-controlled oscillator (VCO) (manufactured by The University of Texas at Austin), then transmitted by VHF radio transmitter (Monitron T16F) and antenna (five-element Yagi, supplied by Monitron). Power was provided by a 12-volt lead-acid battery at each site, changed monthly. The common receiving and recording site was located at the Department of Geology of Stephen F. Austin State University in Nacogdoches. There the radio signals were received by antennas connected to radio receivers (Monitron R16F) on the roof. The audio tones were sent over wires to the room containing the recorder, where they were filtered, converted to voltage levels by discriminators (Teledyne-Geotech 46.12), and

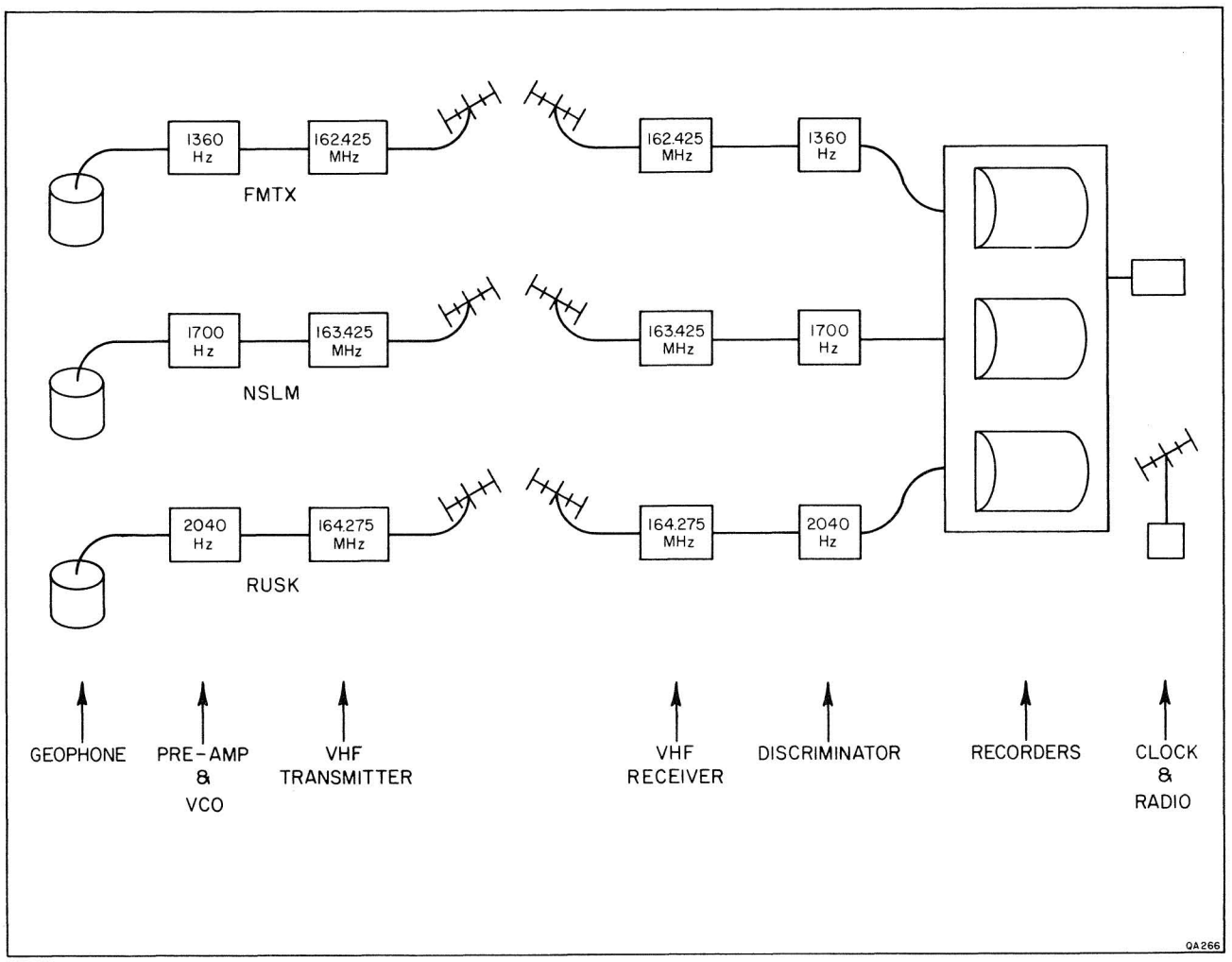
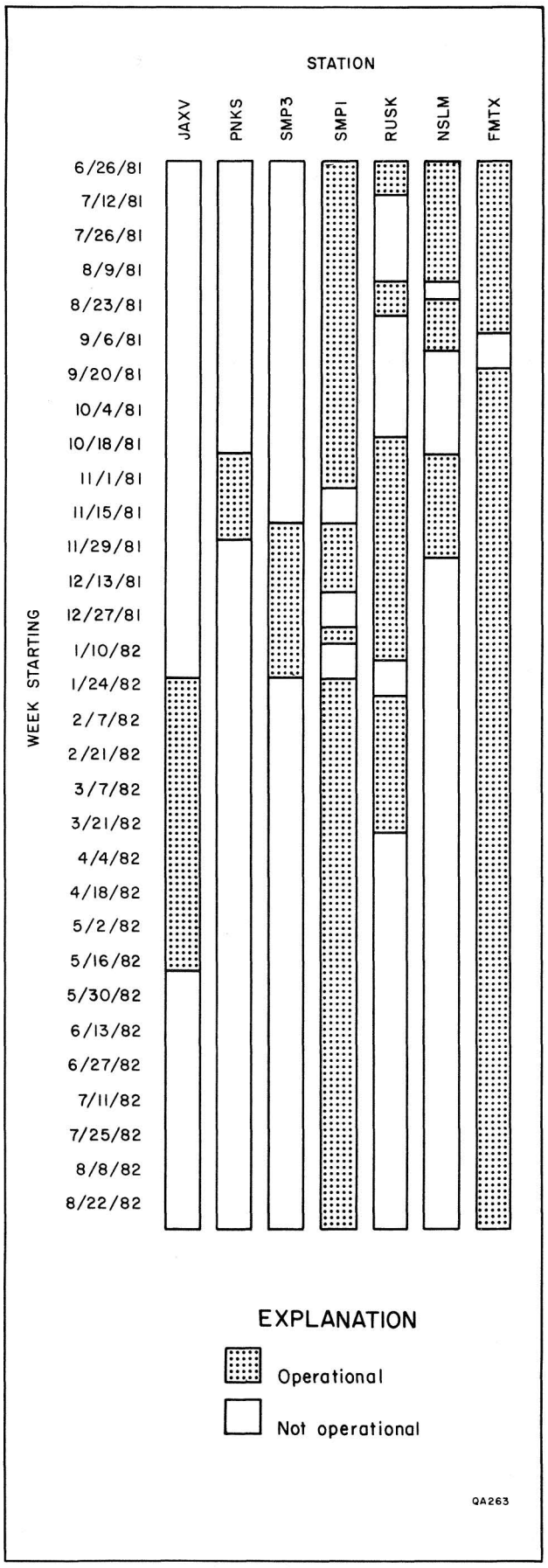


Figure 3. Block diagram of equipment used in telemetry array. Equipment on the left side of the diagram was located at three different remote sites. Data were sent by radio telemetry to Nacogdoches, where the equipment on the right side of the diagram was located.



recorded on pen-and-ink helical drum recorders (Sprengnether VR-60). Accurate timing was provided by a quartz-oscillator-controlled clock (Sprengnether TS-250), corrected daily by a WWV radio receiver. Recording speed was 1 mm/s, enabling precise reading of arrival times. Polarity of the telemetered stations was such that an "up" motion of the recorded trace corresponded to a "down" motion of the ground. Station magnifications were changed at various times, but were generally about 450,000 times at 10 Hz (see fig. 2).

The advantages of operating three stations having a single clock at a single recording site are considerable. Similar starting and ending times for records on each station in the network make recognition of events easier. Routine station maintenance is simplified because one clock correction can be made for all stations and all records can be changed at one convenient indoor location. Most important, the recording of all stations with a single clock greatly improves the accuracy with which relative measurements, such as relative arrival times and apparent velocities of seismic phases, can be made. These advantages, however, are somewhat offset by the increased rate of

Figure 4. Weekly record of operational periods of all telemetered and smoked-paper stations in the East Texas Seismic Network from June 26, 1981, through August 31, 1982. Only every other week is labeled.

equipment failure that results both from the higher level of technical sophistication of each component and from the larger number of components required for each station. In addition, radio interference provides another source of "noise," one that does not affect simpler independent instruments. Equipment failure and radio interference resulted in partial inoperation (one or more stations) of the network (fig. 4).

LOCATION PROCEDURE

All available P-wave and S-wave arrival times from stations in the East Texas Seismic Network and other regional stations were used to locate earthquakes. The earthquake locations were determined by computer programs that search for the "best" hypocentral location in a least-squares sense. A velocity-depth function for P and S waves must be provided by the analyst, along with the arrival times at the stations. The program then finds the location (latitude, longitude, and depth) and origin time that is in best agreement with the observed arrival times. The velocity-depth function used for the locations discussed in this report was derived from different sources for different depth ranges (Navarte, 1946; Cram, 1961; Dorman and others, 1972; Mauk, 1982; Jackson, 1982). The velocity-depth function for P waves is shown in figure 5; a Vp/Vs ratio of 1.73 was assumed. The computer program FASTHYPO (Herrmann, 1979) was used to determine initial hypocentral locations. A program written by Cliff Frohlich (Institute for Geophysics at The University of Texas at Austin), which more directly seeks a true least-squares minimum and includes some convenient options, was used for the final locations presented here. Times are given in UTC; central standard time (CST) is obtained by subtracting 6 hours, and central daylight time (CDT) by subtracting 5 hours.

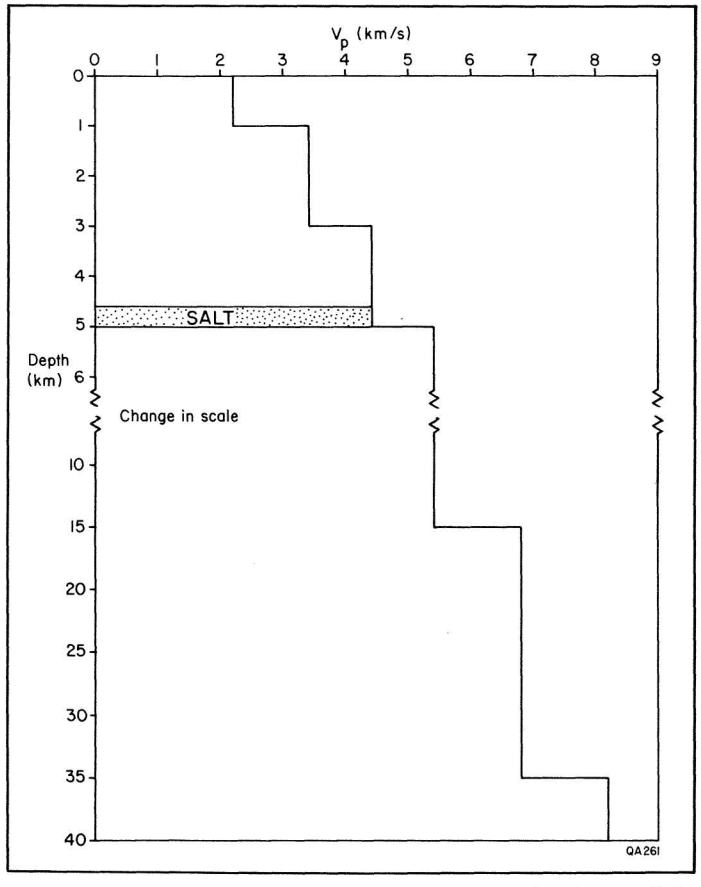


Figure 5. Variation of P-wave velocity with depth, used to determine locations of earthquakes. The scale changes between 6 and 10 km. Depth of the Louann Salt is shown for reference only. It should be noted that the locations determined for the events are only weakly dependent on the specific velocity structure used in the location procedure.

DESCRIPTION OF EVENTS

Located Earthquakes

From June 1981 through August 1982, eight earthquakes in the East Texas Basin were observed (fig. 6). Four of these were located by seismograph recordings. These four included an earthquake near Center on June 9, 1981 (UTC; June 8 CDT); one near Jacksonville on November 6, 1981; an aftershock of the Jacksonville earthquake on November 9, 1981; and an earthquake near Mount Enterprise on December 11, 1981. The computer-derived locations, with station readings, residuals, and error estimates, are presented in table 2 (p. 18). Two additional Jacksonville aftershocks on November 6, 1981, and January 5, 1982, were recorded by only two stations but can be identified from the similarity of waveforms and relative arrival times at the two stations. Two other events, on May 13, 1982, strongly resemble earthquakes but were recorded by only one station. Thus, we observed a total of eight certain or probable earthquakes: four at Jacksonville, one at Center, one at Mount Enterprise, and two unlocated.

Estimates of the focal depths are not well constrained for all the events, as is typical of earthquakes that occur more than a few kilometers from any station or outside the local network. To estimate the precision with which the depth could be determined, we repeatedly "relocated" each event by fixing the depth at various levels and seeking an optimal location at each depth. We then plotted the RMS (root-mean-square) error for each location versus depth (fig. 7). This calculation indicates that all East Texas events must lie between zero and about 12 km depth. Although we have assumed a depth of 3 km for each of the events in determining epicentral locations reported here (for example, table 2), it is impossible to determine if the earthquake hypocenters are in the sedimentary section above the Louann Salt, in the Louann Salt, or in the basement below the salt.

The magnitudes reported for the Center and Jacksonville earthquakes were 3.0 m_{bLg} and 3.2 m_{bLg}, respectively. These magnitudes were computed by the Oklahoma Geophysical Observatory, using a specially filtered seismograph operating near Tulsa (station TUL). The m_{bLg} magnitude scale, developed by Nuttli (1973), is an approximation to the more conventional m_b (Gutenberg-Richter body-wave) magnitude scale. The m_{bLg} scale makes use of Lg waves (high-mode surface waves), which dominate the seismogram at distances up to several hundred kilometers, rather than smaller amplitude body waves.

To determine the magnitudes of other events, we constructed a duration, or coda-length, magnitude scale, M_{coda}. First, we assumed a dependence of the form

$$m_{bLg} \approx M_{coda} = a + b \log (coda),$$

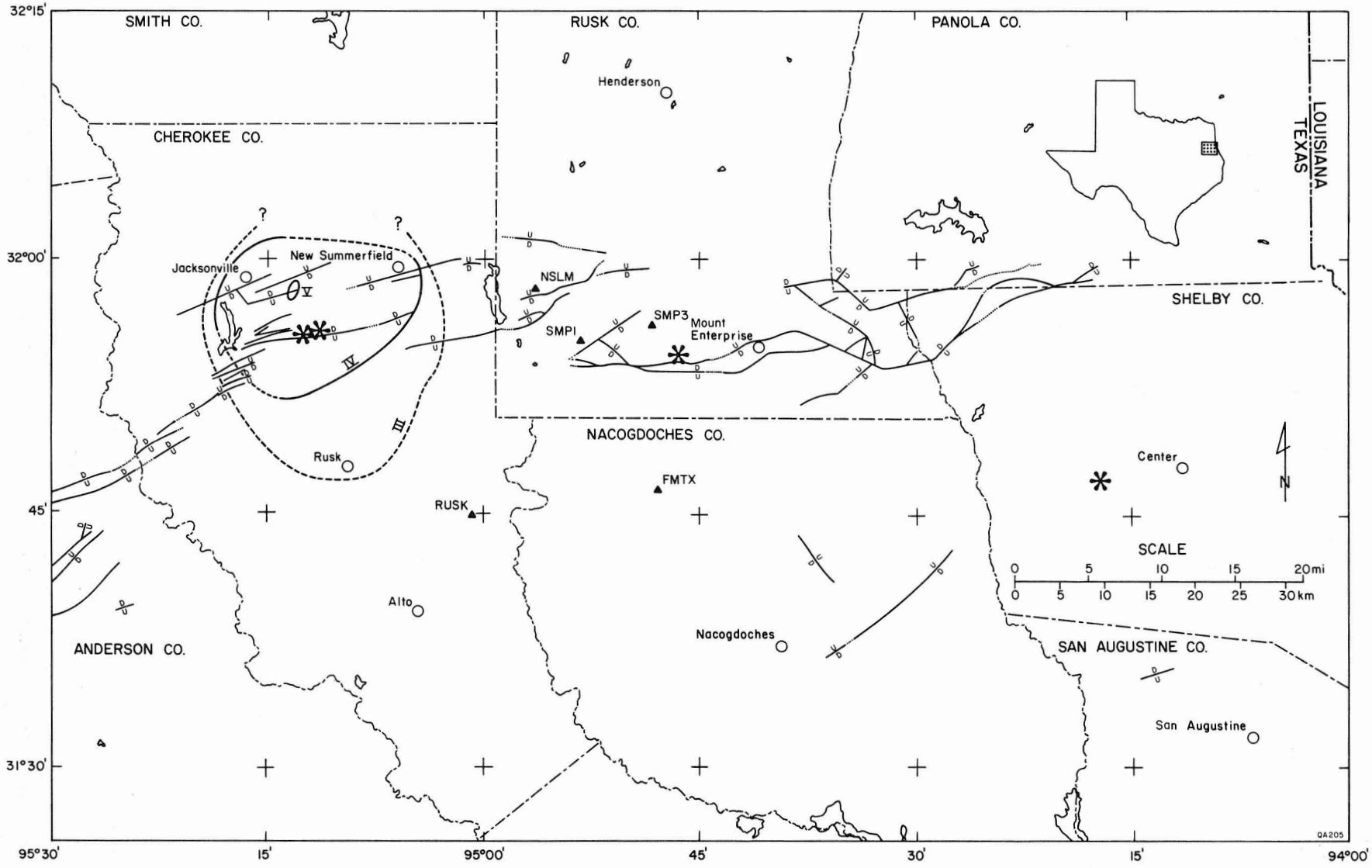


Figure 6. Map of the East Texas area, showing mapped and inferred fault traces (solid and dotted lines, respectively) (taken from the Geologic Atlas of Texas, Tyler and Palestine Sheets, Barnes, 1965 and 1967), station locations (solid triangles), and earthquake epicenters (asterisks). Lines of equal intensity, or isoseismals, for the Jacksonville earthquake are also shown and are labeled with Roman numerals. Earthquake epicenters were located near Jacksonville, Mount Enterprise, and Center.

where (coda) is the duration of the event in seconds, as it appears on the seismogram, and a and b are constants to be determined. Unfortunately, the two earthquakes for which m_{bLg} is available had similar magnitudes, so the constant b cannot be determined from our observations. If we simply assume b = 2.2, as is often the case for coda-length magnitude scales, we can determine that a = -1.79, producing M_{coda} = -1.79 + 2.2 log (coda). The magnitudes can then be determined for the remaining events as follows: the Mount Enterprise earthquake (1.8), the Jacksonville aftershocks (2.1, 1.7, and 1.6, in chronological order), and the two unlocated events in May (2.3 and 1.9).

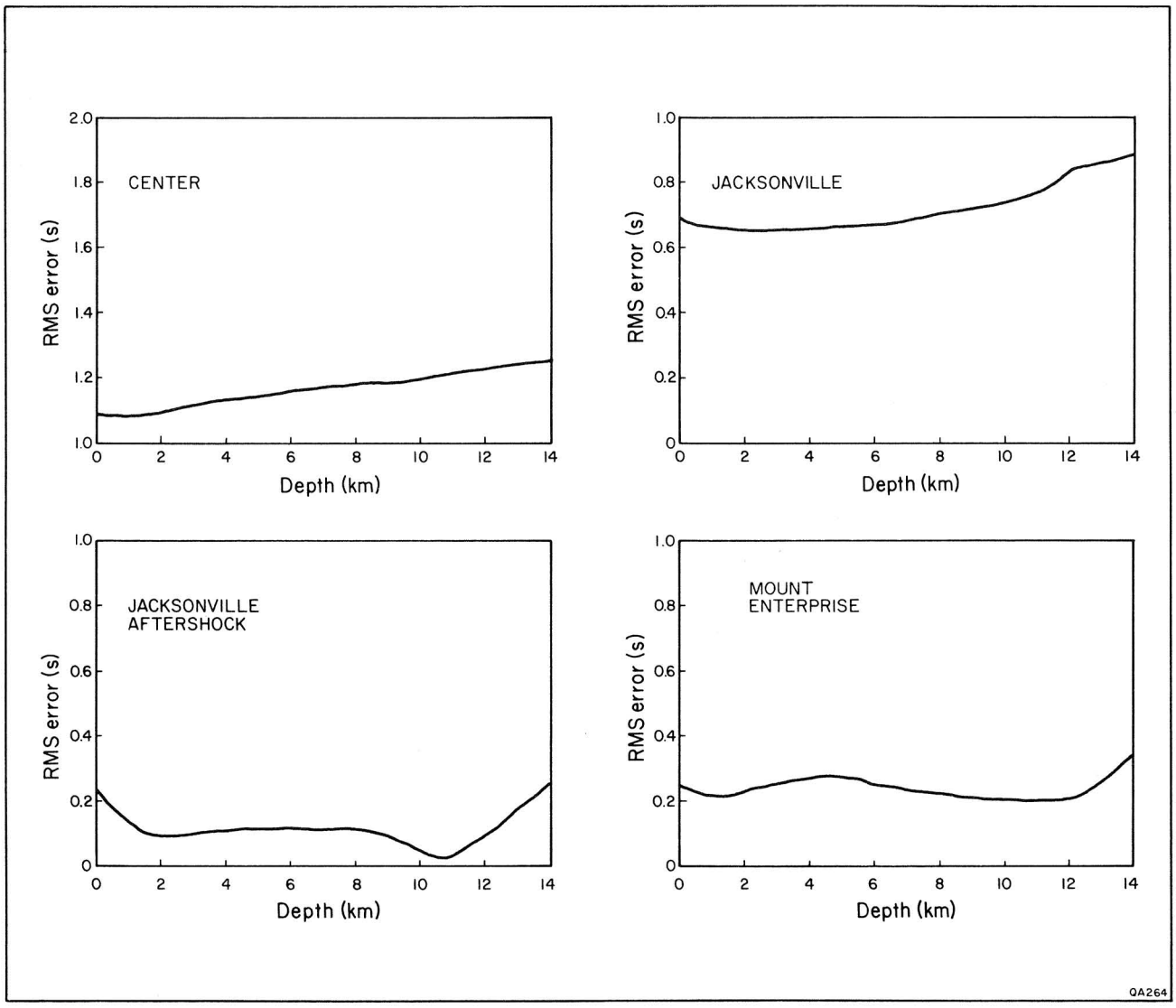


Figure 7. Root-mean-square (RMS) error in seconds versus depth for the four located earthquakes. The RMS error of observed-calculated arrival times for epicentral solutions in which the depth was held fixed at many points indicates that the depth of the events is not well constrained between 0 and 12 km.

Reports of Felt Earthquakes in Center and Jacksonville

The Center earthquake was reported felt by persons in the southwestern part of Center (*East Texas Light* newspaper account, June 12, 1981, and door-to-door questioning). The earthquake was rated III on the Modified Mercalli Intensity scale (MM Scale, Richter, 1958). The extent of the felt area is not known but is apparently small. It is likely that the Center earthquake would have been dismissed as a sonic boom or explosion had the smoked-paper unit of the East Texas Seismic Network not been in operation (National Earthquake Information Service, personal communication, 1981).

The Jacksonville earthquake was felt over a wide area (500 km^2), and its first aftershock, which occurred less than 3 minutes later, was felt over a more limited area (75 km^2) (fig. 8). As a result of the response to a questionnaire published in the *Jacksonville Herald* on November 9, 1981, it was possible to determine the intensities at more than 100 locations. In all, 98 reports for the main shock were assigned intensity ratings from III to V (MM scale). All 50 intensities evaluated for the single felt aftershock were II-III. The area of highest intensity does not quite coincide precisely with the computer-determined locations; this may be the result either of systematic computer mislocation due to lateral velocity heterogeneities, or of soil types and focusing of rays affecting the intensities reported.

Composite Focal Mechanism for the Located Earthquakes

The polarities of the initial P waves recorded by local stations were plotted on a single lower-hemisphere equal-area-projection diagram for each of the located events and aftershocks to determine the mechanism of faulting (fig. 9). Because station coverage for any one event is insufficient to define the focal mechanism, the arrivals from several events were combined on one composite diagram. This approach is valid provided all the events plotted occurred along faults of similar orientation and in response to similar stress fields. The consistency of the data as plotted supports this assumption.

The mechanism that best fits the data indicates normal faulting with a small strike-slip component (fig. 9). One possible fault plane strikes N. 15° E.; the other strikes N. 75° E. and dips 62° to the southeast. The latter plane strikes roughly parallel to the faults of the Mount Enterprise fault system and is the preferred plane of faulting for the observed seismicity in the East Texas Basin.

Events of Undetermined Origin

Table 3 (p. 21) includes listings of seismic-wave arrivals from distant teleseismic earthquakes and explosions, local and regional earthquakes, and hundreds of other local events of

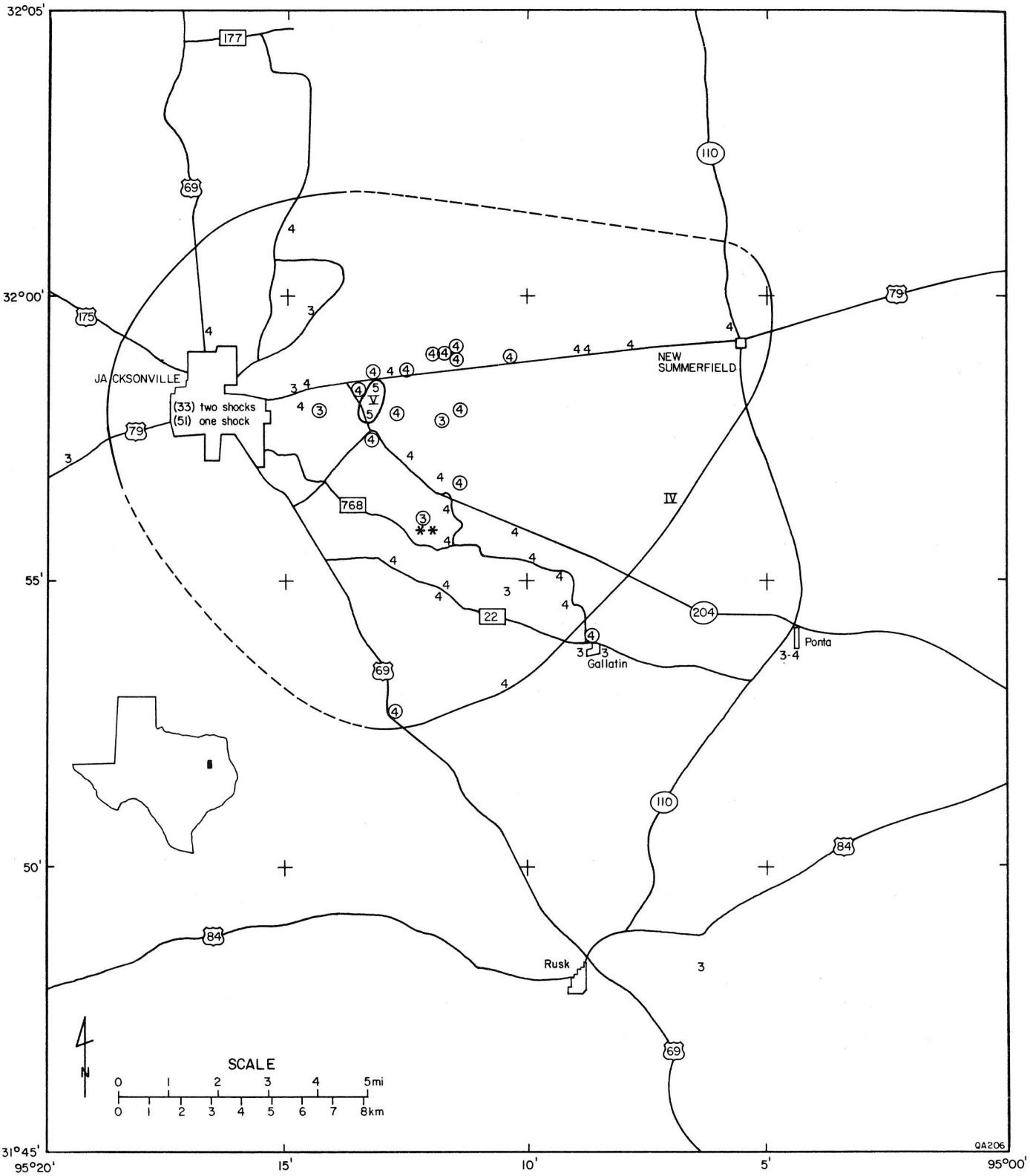


Figure 8. Modified Mercalli Intensity ratings assigned for the Jacksonville earthquake of November 6, 1981. Information was provided in response to a questionnaire published in the *Jacksonville Herald* (November 9, 1981). Intensities assigned for each location are indicated in Arabic numerals; isoseismals are drawn in solid lines (where known) and dashed (where inferred) and are labeled with Roman numerals. Circled Arabic numerals indicate that the first aftershock was also reported felt (at intensity II-III) at that site. Asterisks give locations of the Jacksonville earthquakes' epicenters as determined instrumentally.

undetermined origin. Some of the local events appear to be explosions (perhaps for seismic exploration), some appear to be thunder, others sonic booms, but the origins of most of the small local events are simply not known. Seismograms of some of these events are shown in the photographs in figure 10 (p. 35).

Many of the unlocated events are clearly related to human activity: large swarms of events occur during daylight hours only and are probably explosions used for seismic exploration. But many of these daylight swarms of activity are followed by smaller swarms of very minor events at night. It seems unlikely that man-made explosions (1) would occur randomly in time throughout the day, with occasional groups of events separated by only a few seconds, as is sometimes observed, and (2) could leave residual stresses or strains in the earth sufficient to result in the associated nighttime activity. The possibility that some of these small events are caused by injection of waste salt water is currently under investigation and is consistent with the observations.

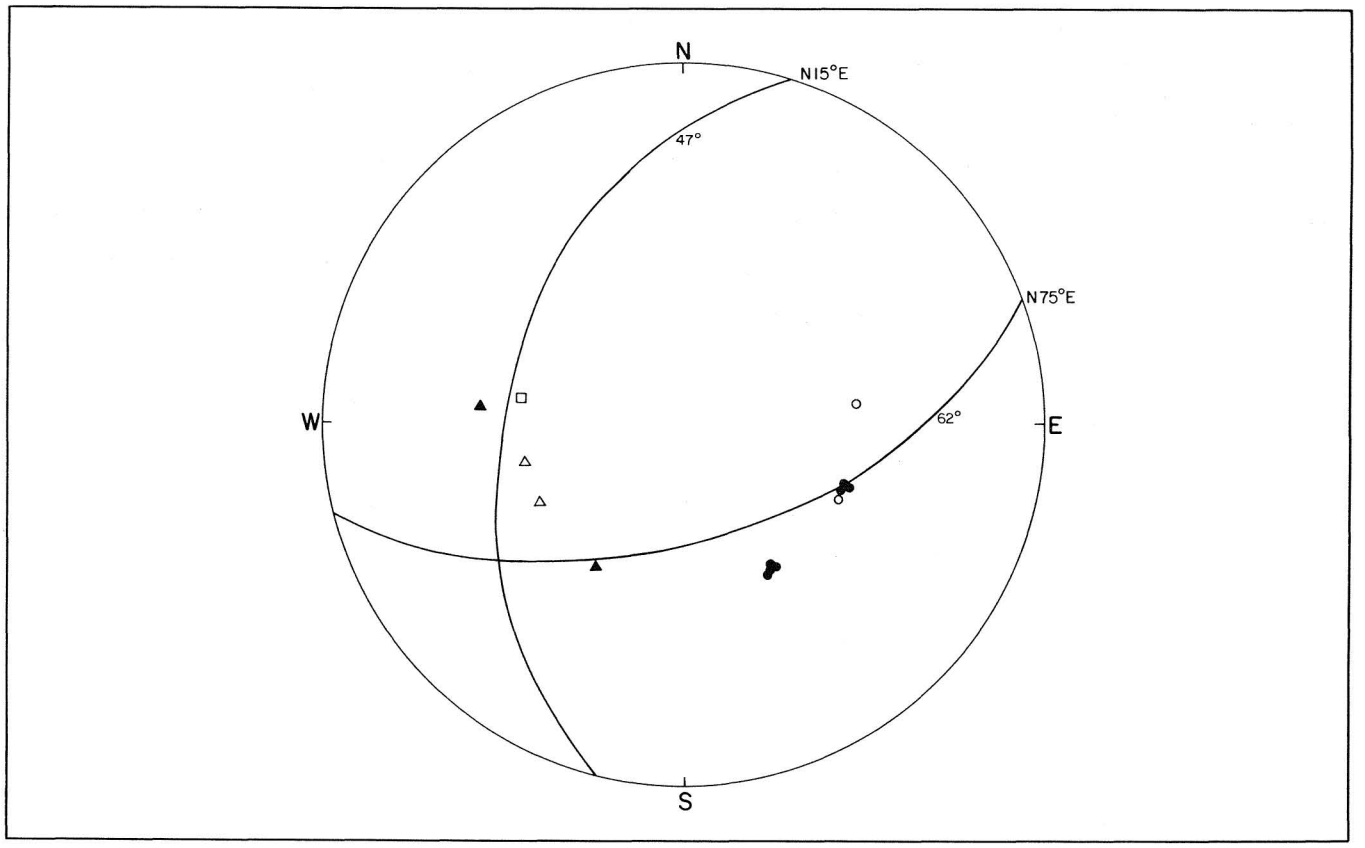


Figure 9. Composite focal mechanism for the located earthquakes and probable aftershocks. Projection is lower-hemisphere equal-area; solid symbols represent compressional P-wave arrivals; open symbols represent dilatational P-wave arrivals. Circles indicate readings from the Jacksonville earthquakes; triangles indicate the Mount Enterprise earthquake, and the square indicates the Center earthquake. Strikes and dips of the nodal planes are labeled.

SUMMARY

During the first year of operation of the East Texas Seismic Network, six certain and two probable earthquakes were recorded. Of these, three events were felt by the local inhabitants: the Center earthquake in June 1981 and two Jacksonville earthquakes in November 1981 (the main shock and an aftershock immediately following it). Before the network was established, the only reported seismic activity in the immediate area of the network was an event at Rusk in 1891, interpreted by some to have been a tornado (Kilbourne and others, 1974), and four events near Mount Enterprise in 1957. Earthquakes in East Texas but outside the area of the network were also felt at Mexia and Wortham in 1932 and at Hemphill in 1964.

Since the Center earthquake probably would have been dismissed as a sonic boom or explosion had the smoked-paper unit of the East Texas Seismic Network not been in operation, it seems plausible that earlier earthquakes have occurred in the East Texas area and have gone unrecognized in the literature. Unfortunately, we have no way of verifying that other events occurred or of determining their frequency of occurrence. As a result, the hazard produced by seismic activity in East Texas, although certainly low, is difficult to evaluate.

The geologic structure responsible for the observed seismicity cannot be identified at present. The poor depth resolution of the events prevents us from determining if they occurred in the sedimentary section (above the Louann Salt), in the Louann Salt itself, or in the basement beneath the salt. All the earthquakes located by the network occurred near the Mount Enterprise fault zone over an east-west segment extending 90 km. The Mount Enterprise fault zone is apparently confined to the upper 5 km of the sedimentary section and consists of a series of en echelon and sub-parallel normal faults. A composite focal mechanism for the recorded earthquakes is consistent with normal faulting on south-dipping faults of the Mount Enterprise fault zone.

In addition to the locatable earthquakes and frequent sonic booms and explosions, several hundred local events of undetermined origin were recorded by the network. Most of these events occurred in swarms during the daytime. We are continuing to investigate whether some of these events are associated with fluid injection.

ACKNOWLEDGMENTS

This research was supported by the U.S. Department of Energy and funded under Contract No. DE-AC97-80ET46617 as part of the Gulf Coast Salt Dome portion of the Nuclear Waste Isolation Program. Significant support, primarily for equipment repair and replacement, was provided by the Department of Geological Sciences, The University of Texas at Austin, and by the Geology Foundation of the department. To supplement the network established under this contract, equipment was loaned to us by the Texas Department of Water Resources and the Institute for Geophysics at The University of Texas at Austin. The Department of Geology of Stephen F. Austin State University generously provided space for the recording equipment and permitted the installation of antennas on the roof of their building. Edward W. Collins of the Bureau of Economic Geology assisted in the installation of equipment, obtained permission for installation from landowners, and assisted in the initial stages of analysis and interpretation. Deborah Magouirk, John R. Hultman, Jr., and Jill O'Neal maintained and monitored equipment. G. Matthew Coldwell provided electronic assistance in the laboratory and in the field.

The manuscript was critically reviewed by L. F. Brown, Jr., R. T. Budnik, T. E. Ewing, M. P. A. Jackson, C. W. Kreitler, and E. D. Orr. Ginger Zeikus typed the original manuscript. Word processing was by Dorothy C. Johnson and Jana J. McFarland, and typesetting was by Phyllis Hopkins, under the supervision of Lucille C. Harrell. Photographs of seismograms were made by David M. Stephens. Drafting of figures was by Richard M. Platt and Jana Brod. Text illustration camerawork was by James A. Morgan. Publication design and assembly were by Jamie S. Haynes. Michelle C. Gilson edited the report.

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Table 1. Stations used in determining epicentral locations of East Texas earthquakes.*

State	Station code	Latitude (°N)	Longitude (°W)
Texas	FMTX	31.772	94.805
	RUSK	31.759	95.085
	NSLM	31.975	94.958
	SMP1	31.902	94.860
	SMP3	31.948	94.817
	HKT	29.950	95.833
	ATX	30.314	97.867
	JCT	30.479	99.802
	CMTX	33.010	100.842
Oklahoma	BHO	34.381	94.867
	WLO	34.065	97.370
	SIO	35.746	96.307
	GBO	35.853	95.184
	TUL	35.911	95.793
	RLO	36.167	95.026
	RRO	35.457	98.358
	QZO	34.905	99.305
	ACO	36.699	99.146
Arkansas	STAR	33.892	91.778
	LGAR	34.652	90.656
	OLY	35.503	91.470
	WLA	35.186	90.719
Alabama	PWLA	34.920	88.064
New Mexico	ALQ	34.943	106.458

*Flower Mountain (FMTX), Rusk (RUSK), and New Salem (NSLM) form the telemetered array. These and the smoked-paper units (SMP1 and SMP3) form the East Texas Seismic Network. Hockley (HKT) and Austin (ATX) are additional stations operated in Texas by The University of Texas at Austin. Station locations are shown in figure 1a.

Table 2. Locations of East Texas earthquakes determined in this study.*

Center Earthquake Location	
Date:	June 9, 1981
Origin Time:	01:46:30.15
Latitude:	31.816° N.
Longitude:	94.265° W.
Depth:	3.0 km

Station	Distance	Azimuth	P Arrival	S Arrival	P TT	S TT	P Residual	S Residual
SMP1	57.04	279.69	01:46:41.85	01:46:50.50	11.70	20.35	-0.23	-0.29
BHO	290.72	348.87	01:47:12.50	01:47:43.80	42.35	73.65	-0.90	-1.17
GBO	456.89	349.29	01:47:33.30	01:48:26.70	63.15	116.55	-0.36	6.67
SIO	476.06	336.64	01:47:36.10	01:48:26.50	65.95	118.35	0.10	2.43
TUL	476.75	342.78	01:47:35.40	01:48:24.50	65.25	114.35	-0.68	0.29
OLY	484.78	32.24	01:47:37.50	01:48:26.90	67.35	116.75	0.44	0.99
JCT	547.53	254.25	01:47:44.50	01:48:40.00	74.35	129.85	-0.22	0.85
CMTX	631.55	282.14	01:47:56.60	---	86.45	---	1.64	---

Number of Stations: 8
RMS Residual: 0.99 second

*The locations reported here were all computed with depth held fixed at 3 km. Times are all in UTC. Distance between earthquake and station is in km. Azimuth refers to heading (°E of N) from earthquake to station. TT indicates travel time in seconds. Residual is observed minus calculated arrival time. RMS refers to root-mean-square. Dashes indicate a lack of data.

Table 2 (cont.)

Jacksonville Earthquake Location

Date: November 6, 1981
Origin Time: 12:36:41.00
Latitude: 31.924° N.
Longitude: 95.198° W.
Depth: 3.0 km

Station	Distance	Azimuth	P Arrival	S Arrival	P TT	S TT	P Residual	S Residual
RUSK	21.24	149.76	12:36:46.20	---	5.20	---	-0.10	---
FMTX	40.81	114.48	12:36:49.90	---	8.90	---	-0.02	---
HKT	227.70	195.42	12:37:16.50	12:37:42.00	35.50	61.00	-0.06	-0.52
BHO	274.93	6.44	12:37:26.70	---	39.70	---	-1.62	---
ATX	310.79	234.83	12:37:26.80	---	45.80	---	0.11	---
WLO	312.56	319.61	12:37:27.00	---	46.00	---	0.09	---
STAR	387.08	55.56	12:37:36.00	12:38:15.36	55.08	94.36	0.01	-0.78
GBO	436.88	0.17	12:37:41.80	---	60.80	---	-0.27	---
SIO	437.14	346.45	12:37:41.80	---	60.60	---	-0.50	---
TUL	446.71	352.94	12:37:43.50	---	62.50	---	0.23	---
JCT	466.42	249.85	12:37:46.00	---	65.00	---	0.33	---
RLO	472.06	1.93	12:37:45.90	---	64.90	---	-0.46	---
RRO	489.68	323.34	12:37:47.20	---	66.20	---	-1.31	---
QZO	505.13	311.01	12:37:51.00	---	70.00	---	0.61	---
LGAR	519.87	54.30	12:37:52.92	12:38:40.81	71.92	119.61	0.73	-3.35
OLY	526.58	40.91	12:37:53.56	12:38:46.31	72.56	125.31	0.55	0.74
WLA	551.22	48.85	12:37:56.09	12:38:51.41	75.09	130.41	0.08	0.64
ACO	642.94	325.67	12:38:07.50	---	86.50	---	0.30	---

Number of Stations: 18
RMS Residual: 0.57 second

Table 2 (cont.)

Jacksonville Aftershock Location

Date: November 9, 1981
Origin Time: 08:42:17.91
Latitude: 31.949° N.
Longitude: 95.550° W.
Depth: 3.0 km

Station	Distance	Azimuth	P Arrival	S Arrival	P TT	S TT	P Residual	S Residual
RUSK	24.66	148.82	08:42:23.90	---	5.99	---	0.06	---
NSLM	24.91	83.27	08:42:23.90	08:42:28.30	5.99	10.39	0.01	0.05
FMTX	43.86	116.62	08:42:27.30	---	9.39	---	-0.10	---

Number of Stations: 3
RMS Residual: 0.06 second

Mount Enterprise Earthquake Location

Date: December 11, 1981
Origin Time: 12:14:42.71
Latitude: 31.935° N.
Longitude: 94.673° W.
Depth: 3.0 km

Station	Distance	Azimuth	P Arrival	S Arrival	P TT	S TT	P Residual	S Residual
SMP3	13.65	275.93	12:14:46.60	12:14:49.50	3.89	6.79	0.07	0.19
SMP1	18.02	258.14	12:14:47.00	---	4.29	---	-0.41	---
FMTX	22.02	214.45	12:14:48.25	12:14:52:20	5.54	9.49	0.10	0.07
RUSK	43.57	243.25	12:14:52.20	12:14:58.60	9.49	15.89	0.06	-0.43

Number of Stations: 4
RMS Residual: 0.20 second

Table 3. Catalog of arrival times (in UTC) for events recorded by the East Texas Seismic Network.

Photo No.	Date	Event Description	Station FMTX	Station NSLM	Station RUSK	Station SMP1
	1981					
	6/27		Start	Start	Start	Continued operation
		Teleseism (M = 4.2)‡ Jalisco, Mexico‡	01:00:53.0	Cyclic noise (period 8 minutes)	On, but not functioning	
		Teleseism (M = 5.1) Peru-Ecuador border	22:01:23.9			
	6/29	Teleseism (M = 5.0) Chiapas, Mexico	04:09:51.2			
2*		Impulsive local events	15:02:19.0 15:03:09.5 15:05:26.0 22:15:02.8 22:15:20.2			15:02:52.0 15:03:42.5 15:05:19.5 15:06:08.0 22:15:34.1 22:15:50.4
		Many impulsive local events (~ 30)	18:00 - 24:00			
	6/30	Many small impulsive local events	00:00 - 07:30			
3	7/1	Local event (slow-moving waves)	22:54:49.9		22:56:03.2	22:55:28.2
3	7/2	Local event (slow-moving waves)	00:26:07.3	00:27:12.0	00:27:24.0	
3		Local event (slow-moving waves)	01:40:42.4	01:41:48.0	01:41:46.0	01:41:13.2
		Several impulsive local events	17:30 - 24:00			
		Local event	23:21:55.7			
		Local event	23:32:35.3			
	7/3	Teleseism (M = 5.3) Greece-Albania border	21:55:43.6		21:55:44.0	
	7/4	Teleseism (M = 4.7) Oaxaca, Mexico	05:34:06.7		05:34:07.8	05:34:09.7
	7/5	Local event (slow-moving waves)	11:31:23.0	11:30:05.6	11:31:06.2	11:30:40.0
	7/6	Teleseism (M = 5.0) Java	00:20:05.0	00:20:05.5	00:20:05.2	00:20:05.6
		Teleseism (M = 5.6) Tonga Islands	01:15:16.7	01:15:17.6	01:15:16.5	01:15:17.1
		Teleseism (M = 6.9) Loyalty Islands	03:22:32.0		03:22:31.0	03:22:31.2
	7/7	Teleseism (M = 4.6) Chiapas, Mexico	06:18:25.5		06:18:27.5	06:18:32.0
		Teleseism (M = 5.0) South of Panama	10:32:15.8		10:32:15.9	10:32:16.0
		Teleseism (M = 5.7) Central Mid-Atlantic Ridge	21:23:01.0		21:23:01.0	21:23:02.0
		Several impulsive local events	19:00 - 24:00			
	7/8	Local events (slow-moving waves)	23:31:32.5		23:31:08.8	
	7/11	Teleseism (M = 4.9) Aleutian Islands	09:07:51.5			
		Regional event (M = 3.5) Oklahoma	21:10:26.0			21:10:30.0
	7/13	Teleseism (M = 5.4) Aleutian Islands	22:20:05.9			22:20:05.4

*Bold-face numbers indicate number of photograph in figure 10.
‡Location and magnitude (M) for distant events were obtained from the Preliminary Determination of Epicenters (PDE) of the National Earthquake Information Service, U.S. Geological Survey.

Table 3 (cont.)

Photo No.	Date	Event Description	Station FMTX	Station NSLM	Station RUSK	Station SMP1
	1981					
	7/16	Teleseism (M = 5.1) Carlsberg Ridge	09:31:31.0			09:31:29.0
	7/17	Teleseism (M = 4.9) Tonga Islands	03:22:05.4			03:22:05.0
		Impulsive local events	02:47 - 04:39			02:47 - 04:39
	7/18	Impulsive local events	00:00 - 24:00			00:00 - 24:00
	7/21	Teleseism (M = 5.1) Guerrero, Mexico	09:18:00.5			09:18:02.5
		Teleseism (M = 4.8) Guerrero, Mexico	09:23:51.8			09:23:52.8
		Teleseism (M = 5.2) Guerrero, Mexico	10:26:30.5			
	7/24	Teleseism (M = 4.8) Oaxaca, Mexico	07:37:22.5			
		Local event (sonic boom)	14:51			14:51
	7/26	Teleseism (M = 5.3) Guerrero, Mexico				04:17:56.6
	8/1	Teleseism (M = 5.1) Southern Alaska	01:50:41.2			01:50:40.0
		Teleseism (M = 5.7) Tonga Islands	06:23:10.5			06:23:11.0
		Teleseism (M = 5.0) Guerrero, Mexico	11:23:36.5			11:32:37.5
		Local events with several-minute spacing and similar amplitudes and waveforms. First arrivals all compressional (probably explosions).	19:33:33.0			19:07:26.6 (P) 27.4 (S) 32.8 (Surface) 19:10:25.4 (P) 26.2 (S) 37.7 (Surface) 19:33:49.4 (P) 50.2 (S) 55.2 (Surface) 19:38:02.8 (P) 03.6 (S) 08.0 (Surface)
			20:26:29.0			20:26:23.0 (P) 23.7 (S) 28.2 (Surface)
			20:31:04.5			20:31:34.8 (P) 35.5 (S) 40.0 (Surface)
		Local events	20:35:15.0			20:35:07.8 (P) 08.5 (S) 13.5 (Surface)
			20:41:20.0			20:41:14.9 (P) 15.8 (S)
			20:42:25.0			20:42:16.9 (P) 17.7 (S) 22.0 (Surface) 21:47:23.5 (P) 24.3 (S) 28.5 (Surface) 22:30:12.4 (P) 13.1 (S) 21.2 (Surface)
	8/4	Teleseism (M = 4.5) Chiapas, Mexico	02:25:19.8			
		Numerous local events	04:50 04:58			13:41 - 21:57
		Teleseism (M = 5.3) Leeward Islands	22:06:53.6			22:06:54.5

Table 3 (cont.)

Photo No.	Date	Event Description	Station FMTX	Station NSLM	Station RUSK	Station SMP1
	1981					
		Local events				22:10 22:19
	8/5	Local events				15:53 16:45 16:52 16:55 16:59
			17:03 17:10 17:16			17:03 17:10 17:16
	8/6	Local events				15:18 15:25 15:32 16:19 16:24 16:30 18:30 18:35 18:39
	8/7	Local events				00:28 00:34 00:38 00:42 15:45 15:55 16:00 16:34 21:31 21:38 23:17 23:23
	8/8	Local events				18:41 19:02 19:11 19:42 19:49 19:54 20:05
	8/11	Teleseism (M = 5.1) Nicaragua	06:02:08.8			
		Local events (many impulsive signals)	14:18 14:28 14:37 14:43 14:47 14:57 19:06 19:22 20:15 20:30			14:18 14:28 14:43 14:47 14:57 15:01 19:02 19:06 19:17 19:22 20:15 20:20 20:25 20:30 20:38
4	8/12	Local events (many impulsive signals)	18:00 - 24:00			15:00 - 24:00
5	8/13	Very short impulsive local events	22:35			22:35
	8/14	Local events	03:42 - 05:21 15:31 - 20:16			03:42 - 05:51 14:12 - 17:42
	8/15	Local events	03:43 - 06:45			04:25 - 07:00 15:15 - 21:47
		Teleseism (M = 5.1) Alaska Peninsula	10:39:39.0			10:39:38.8

Table 3 (cont.)

Photo No.	Date	Event Description	Station FMTX	Station NSLM	Station RUSK	Station SMP1
	1981					
		Local event (sonic boom)	14:12:06.0			
	8/16	Local events	15:10 - 22:55		15:10 - 22:55	
		Teleseism (M = 4.8) Peru-Chile region	21:54:53.8		21:54:54.8	21:54:55.6
	8/17	Local events	00:00 - 09:00			16:00 - 24:00
		Teleseism (M = 5.8) Chiapas, Mexico	02:22:59.5		02:23:03.8	02:23:04.0
		Local events (impulsive - no surface waves)	18:00 - 24:00			18:00 - 24:00
	8/19	Local events	16:00 - 24:00			16:00 - 24:00
		Teleseism (M = 6.0) Mid-Indian Ocean Rise	23:10:49.0		23:10:49.0	23:10:48.8
	8/20	Local events	02:00 - 06:00			02:00 - 06:00
		Small impulsive local events				
	8/21	Local events	00:00 - 24:00			
		Local event (sonic boom)	13:39:32	13:39:09		13:39:03
		Local event (S–P time = 3 seconds)	20:25:44.6			
	8/23	Local events with differing amplitudes but similar waveforms (S–P time = 2 seconds)	15:00 15:08 15:17 15:22 15:29 15:35 15:40		15:08 15:17	
	8/24	Local events (S–P time = 1.5 seconds)	18:43 18:49 19:25			
	8/25	Local events (S–P time = 1.5 seconds)	16:58 17:27 18:44 18:48			16:29 16:53
6	8/26	Local events (S–P time = 1 second)	16:00 16:29 16:50 18:17 18:28 19:08 19:20			
	8/27	Local events (at least 12) (S–P time = 1 second)	14:17 - 21:00			14:00 - 20:00
	9/1	Teleseism (M = 7.8) Samoa Islands		09:42:22.5		09:42:23.0
		Impulsive local events				14:00 - 20:00
	9/3	Teleseism (M = 6.6) Kuril Islands				05:48:23.5
	9/5	Local events (25) with large amplitudes and similar waveforms				15:00 - 20:00
	9/9	Local, similar events				16:00 - 24:00
	9/10	Local, similar events				15:00 - 24:00
	9/12	Local, similar events				16:00 - 24:00
		Teleseism (M = 6.2) Northwestern Kashmir	07:35:07.0			
	9/13	Teleseism (M = 5.7) North Mid-Atlantic Ridge	09:27:34.0			09:27:36.0
	9/14	Teleseism (M = 5.8) Caribbean region				12:50:01.0

Table 3 (cont.)

Photo No.	Date	Event Description	Station FMTX	Station NSLM	Station RUSK	Station SMP1
	1981					
	9/17	Local events				16:00 - 23:00
	9/18	Impulsive local events				16:00 - 23:00
	9/19	Local events				18:00 - 24:00
	9/20	Teleseism (M = 5.1) Argentina				10:58:11.7
		Local events (S–P time = 2 seconds)	17:00 - 22:00			17:00 - 22:00
	9/25	Teleseism (M = 4.5) California/Nevada	06:55:15.0			06:55:17.0
	9/27	Teleseism (M = 5.0) Guatemala	13:36:35.0			13:36:36.5
	9/28	Local events (S–P time = 1 second)				16:00 - 20:00
	9/29	Local, similar events				17:00 - 24:00
	9/30	Teleseism (M = 5.6) California/Nevada	11:58:10.7			11:58:11.0
	10/1	Local events				16:00 - 19:00
	10/3	Teleseism (M = 5.2) Jalisco, Mexico				23:04:32.0
	10/4	Teleseism (M = 5.2) Ecuador	20:10:44.9			20:10:46.3
	10/6	Local events (thunderstorm)				10:00 - 24:00
7, 8	10/9	Local events (thunderstorm)	14:56:47.5 15:13:17.8	14:56		14:56 15:13
	10/11	Impulsive local events				16:13:35.0
	10/14	Teleseism (M = 4.9) Nicaragua	08:14:01.5			08:14:03.5
	10/15	Teleseism (M = 6.0) Honshu, Japan	02:00:54.0			02:00:54.5
		Local events				20:00 - 24:00
	10/16	Teleseism (M = 7.5) Central Chile	03:36:38.3	03:36:40.5		03:36:40.2
	10/17	Teleseism (M = 6.1) Banda Sea	07:03:51.0			07:03:54.0
		Teleseism (M = 5.8) Celebes Sea	20:24:43.0			20:24:43.5
	10/18	Teleseism (M = 5.4) Venezuela	04:37:20.2			04:37:22.2
	10/20	Teleseism (M = 4.9) Guerrero, Mexico	06:52:48.0			06:52:47.0
	10/25	Teleseism (M = 4.5) Michoacan, Mexico	03:25:48.8			03:25:50.2
		Teleseism (M = 4.5) Michoacan, Mexico	07:43:30.5			07:43:32.5
	10/28	Teleseism (M = 5.9) Easter Island	04:44:51.5		04:44:57.0	04:44:57.6
	10/31	Teleseism (M = 5.2) Peru	10:22:09.5		10:22:10.5	
	11/1	Teleseism Caribbean region	17:08:19.0			
		Teleseism (M = 5.1) Guerrero, Mexico	23:22:05.5		23:33:09.5	
	11/2	Teleseism (M = 5.7) Andaman Islands	21:33:16.5		21:33:17.0	21:33:16.8
	11/3	Teleseism (M = 5.5) Ecuador	07:09:36.0		07:09:37.0	07:09:37.5

Table 3 (cont.)

Photo No.	Date	Event Description	Station FMTX	Station NSLM	Station RUSK	Station SMP1	Station SMP3
	1981						
		Teleseism (M = 5.8) Oregon	13:53:31.5		13:53:31.5	13:53:31.0	
	11/4	Teleseism (M = 5.9) Tonga Islands	14:51:18.0			14:51:18.5	
	11/5	Teleseism (M = 4.5) Guerrero, Mexico	17:08:07.5		17:08:07.7		
9, 10	11/6	*Jacksonville earthquake*	12:36:49.8		12:36:46.2		
9, 10		*First Jacksonville aftershock*	12:39:39.7	(SMP1 equipment moved to site of NSLM at 20:34)	12:39:36.0		
	11/7	Teleseism (M = 6.1) Chile	03:40:41.0	03:40:42.5	03:40:42.2		
		Teleseism (M = 5.2) Guatemala	22:06:42.8	22:06:45.5	22:06:43.3		
11		Possible local event	23:36:36.0	23:36:11.5			
	11/8	Teleseism (M = 5.8) Java	13:59:48.0	13:59:48.0	13:59:48.0		
12, 13, 14	11/9	*Second Jacksonville aftershock*	08:42:27.4	08:42:24.0 08:42:28.4 (S)	08:42:23.9		
		Teleseism (M = 5.5) Fox Islands	16:54:29.0	16:54:28.0	16:54:28.0		
	11/12	Teleseism Nuclear explosion - Nevada Test Site	15:04:17.0		15:04:15.3		
		Teleseism (M = 5.2) Sumatra	19:47:24.5		19:47:24.0		
	11/13	Teleseism (no PDE data)	00:52:17.2		00:52:13.0		
	11/17	Teleseism (M = 5.2) Chile	07:21:38.8	07:21:40.5			
		Local event		18:03			
	11/22	Teleseism (M = 3.9) Guerrero, Mexico	01:23:14.0		01:23:09.8	(NSLM equipment moved back to site of SMP1)	
		Teleseism (M = 4.9) Oregon	11:43:52.0		11:43:50.5		
	11/23	Teleseism (M = 5.9) Japan	10:30:07.4		10:30:06.3		10:30:06.5
	11/25	Teleseism (M = 5.7) Tonga Islands	19:14:39.5				
	11/30	Teleseism (M = 5.3) Peru	15:51:42.0				
	12/1	Teleseism (no PDE data)	22:30:51.3				
	12/2	Teleseism (M = 5.8) Japan	06:37:39.8		06:37:38.5		
		Teleseism (M = 5.7) South Indian Ocean	19:52:52.4		19:22:53.0		
	12/5	Teleseism (M = 5.3) Arabian Sea	19:05:58.8				
	12/6	Teleseism (M = 5.5) Mid-Atlantic Ridge	15:04:18.9				
	12/8	Teleseism (M = 5.4) Sumatra	08:38:32.1		08:38:33.7		08:38:32.5
15-18	12/11	*Mount Enterprise Earthquake*	12:14:49.0		12:14:52.0	12:14:46.9	12:14:46.8
	12/12	Teleseism (M = 5.5) Michoacan, Mexico	05:01:48.1				

Table 3 (cont.)

Photo No.	Date	Event Description	Station FMTX	Station NSLM	Station RUSK	Station SMP1	Station SMP3
	1981						
		Teleseism (M = 5.5) Maldive Islands	23:50:37.2				
	12/13	Teleseism (M = 5.6) Java	20:55:32.0				
		Teleseism (M = 5.2) Colombia	21:46:51.5				21:46:52.7
	12/14	Teleseism (M = 5.1) Chile	04:05:24.3				
		Teleseism (M = 5.3) Kamchatka Peninsula	09:50:55.0				
	12/16	Possible local event					16:50
	12/19	Teleseism (M = 6.2) Aegean Sea	14:23:56.0				
	12/21	Regional event (M = 5.1) Chiapas, Mexico	10:36:08.5		10:36:08.6		
	12/25	Teleseism (M = 4.2) Central America	00:10:45.0		00:10:46.0		
	12/27	Teleseism (M = 6.2) Russian nuclear explosion	03:56:56.8		03:56:57.0		
	1982						
	1/1	Teleseism (M = 6.5) Bonin Islands	19:04:48.5				
	1/2	Teleseism (M = 5.2) Guerrero, Mexico	03:34:41.9		03:34:41.0		
		Teleseism (M = 5.3) Guerrero, Mexico	07:09:35.0		07:09:37.0		
	1/3	Teleseism (M = 6.3) Mid-Atlantic Ridge	14:21:46.3				
19, 20	1/5	*Third Jacksonville aftershock*	17:05:24.4		17:05:21.04		
	1/7	Teleseism (M = 5.9) Gilbert Islands	08:55:48.0		08:55:48.1		
	1/9	Teleseism (M = 4.7) El Salvador	01:59:38.0		01:59:33.5		
		Teleseism (M = 5.8) New Brunswick	12:59:29.8		12:59:31.1		
	1/11	Teleseism (M = 5.4) New Brunswick	21:46:45.8		21:46:47.8		
	1/12	Teleseism (M = 5.8) Honduras	05:52:51.5		05:52:52.8		
	1/13	Local event (sonic boom)	20:56		20:58		20:57
21	1/14	Local event (sonic boom)	19:10		19:12		19:11
	1/16	Local event (sonic boom)	19:56				19:56
	1/17	Local event (sonic boom)	19:52				19:52
	1/18	Regional event (M = 3.2) Arkansas	01:24:10.5				
		Regional event Arkansas	02:33:16.0 02:34:02.2 (S)				
		Teleseism Aegean Sea	19:40:25.5				
	1/19	Regional event Arkansas	04:40:52.5				
	1/20	Regional event (M = 3.4) Arkansas	14:02:32.7				
		Teleseism (M = 5.2) Windward Islands	15:22:46.8				
	1/21	Regional event (M = 4.5) Arkansas	00:34:56.4				00:34:55.2

Table 3 (cont.)

Photo No.	Date	Event Description	Station FMTX	Station NSLM	Station RUSK	Station SMP1	Station SMP3
	1982						
		Regional event (M = 3.1) Arkansas	01:14:41.2				
		Regional event (M = 3.1) Arkansas	15:46:39.8				15:46:38.8
		Teleseism (M = 5.5) Hawaii	22:38:52.0				
	1/22	Regional event (M = 3.7) Arkansas	23:55:24.8				23:55:23.4
	1/24	Regional event (M = 4.3) Arkansas	03:23:46.5				03:23:45.0
	1/25	Teleseism (M = 6.0) Aleutian Islands	05:38:49.2				(SMP3 equipment moved to site of SMP1)
	1/27	Local event (sonic boom)	18:17			18:17	
	1/28	Teleseism Nuclear explosion - Nevada Test Site	16:04:18.0				
	1/29	Teleseism (M = 5.7) Mid-Atlantic Ridge	22:40:13.8				
	1/30	Teleseism (M = 6.0) Leeward Islands	02:41:48.5			02:41:49.5	
	2/1	Regional event Arkansas	05:56:10.8				
		Regional event Arkansas	07:26:05.9				
	2/2	Regional event (M = 3.4) Arkansas	09:28:11.9			09:28:11.1	
	2/6	Teleseism (M = 5.3) Northern California	12:07:37.3				
	2/7	Teleseism (M = 5.2) Aleutian Islands	06:17:23.7				
		Teleseism (M = 5.0) Gulf of California	19:22:04.0				
	2/8	Local events (possible thunderstorm)	17:41 17:46			17:26 17:31 17:56	
	2/10	Teleseism Kamchatka Peninsula	01:24:52.0				
		Teleseism (M = 5.9) Argentina	20:47:52.0			20:47:53.6	
	2/12	Teleseism Nuclear explosion - Nevada Test Site	14:59:22.5				
		Teleseism Nuclear explosion - Nevada Test Site	15:29:20.8				
	2/13	Local event (sonic boom)	17:39			17:39	
	2/15	Teleseism (M = 5.4) Gilbert Islands	06:03:11.0				
	2/18	Local event (sonic boom)	17:55				
	2/23	Local event (sonic boom)	14:10:33.8			14:10:10.4	
	2/24	Regional event (M = 3.9) Arkansas	19:28:17.0			19:28:16.0	
	2/28	Teleseism (M = 4.8) Mexico-Guatemala area	08:00:09.5			08:40:13.3	
		Teleseism (M = 5.6) Sumbawa	17:56:56.7				
	3/1	Regional event (M = 3.9) Arkansas	00:13:12.5				

Table 3 (cont.)

Photo No.	Date	Event Description	Station FMTX	Station NSLM	Station RUSK	Station SMP1
	1982					
		Teleseism (M = 5.1) Chiapas, Mexico	19:03:31.0			
	3/3	Local event	19:11:22.4			19:10:58.2
	3/4	Teleseism (M = 5.2) El Salvador	11:45:25.2			11:45:27.2
22	3/6	Local events (thunderstorm?)	04:45:28.0 05:07:32.0 05:10:09.6 05:10:42.2 10:17 10:35 10:39 11:02 11:18			04:44:49.6 05:07:54.1 05:19 10:16 10:35 10:38 11:01 11:18
		Teleseism (M = 4.9) Off coast of Central America	21:29:12.8			
	3/7	Teleseism (M = 4.5) Off coast of Central America	03:32:08.8			
	3/10	Teleseism (M = 4.3) Off coast of Central America	05:16:23.0			
	3/11	Teleseism (M = 6.1) Sumbawa	10:51:55.5			
	3/12	Local event (sonic boom)	18:13:13.8			18:12:51.0
	3/16	Teleseism (M = 5.6) Gilbert Islands	00:33:41.0			
		Teleseism (M = 5.1) Chiapas, Mexico	06:44:51.0			
		Teleseism (M = 4.8) Philippines	08:10:06.0			
		Teleseism (M = 4.9) Chiapas, Mexico	10:55:54.5			
	3/17	Teleseism (M = 4.2) Guerrero, Mexico	05:27:31.4			
		Teleseism (M = 4.7) Yugoslavia	14:01:01.3			
		Teleseism (M = 5.0) Gilbert Islands	19:46:27.1			
	3/21	Teleseism (M = 6.4) Hokkaido, Japan	02:45:02.1			
		Teleseism (M = 5.0) Off coast of Central America	03:03:53.5			
		Teleseism (M = 4.4) Northern Mexico	09:41:18.3			
	3/22	Local event (sonic boom)	13:57:37.6			
		Teleseism (M = 5.1) Chile-Bolivia border	21:53:45.0			
	3/28	Teleseism (M = 6.1) Near coast of Peru	23:33:21.2			
	3/29	Teleseism (M = 6.0) Minhassa Peninsula, Sulawesi	21:52:50.0			
	4/3	Local event				02:07:40.7
	4/6	Teleseism (M = 5.2) Chiapas, Mexico	15:53:53.0			
		Teleseism (M = 4.7) Jalisco, Mexico	17:28:21.2			
		Teleseism (M = 5.8) Chiapas, Mexico	20:00:56.8			
	4/7	Teleseism (M = 5.2) Costa Rica	19:25:50.0			

Table 3 (cont.)

Photo No.	Date	Event Description	Station FMTX	Station NSLM	Station RUSK	Station SMP1
	1982					
	4/10	Teleseism (M = 4.9) Japan	00:08:46.5			
		Teleseism (M = 5.6) South Indian Ocean	07:07:50.4			
		Teleseism (M = 5.6) Caribbean area	16:29:38.8			16:29:42.0
	4/11	Local event (sonic boom)	14:05:09.8			
	4/12	Teleseism (M = 5.5) Kuril Islands	01:45:09.8			
23, 24		4 local events	16:32 17:26 18:44 19:08			
	4/13	Teleseism (M = 5.4) Southern Sumatra	15:11:13.2			
		Local events (2 sonic booms)	18:51:48.0 19:38:27.5			19:38:05.0
	4/15	Teleseism (M = 5.4) Southern Sumatra	15:11:13.2			
		Local event (sonic boom)	16:54:48.0			
	4/16	Teleseism (M = 6.4) Tonga Islands	14:17:42.7			
	4/17	Local event (thunderstorm)				06:45
	4/18	Teleseism (M = 5.2) Guatemala	10:46:14.2			
		Teleseism (M = 5.9) Easter Island	11:41:21.0			
		Teleseism (M = 4.2) Michoacan, Mexico	16:03:24.0			
	4/19	Local event (thunderstorm)	02:00 - 03:00			
		Teleseism (M = 5.3) Argentina	12:04:14.7			12:04:15.9
	4/20	Teleseism (no PDE data)	02:05:21.8			
	4/23	Teleseism (M = 5.6) Aleutian Islands	23:28:49.0			
	4/25	Teleseism (M = 5.5) Nuclear explosion - Nevada Test Site	18:09:22.2			
	4/27	Teleseism (M = 4.9) Honduras	00:18:17.5			
	4/28	Local event (sonic boom)	19:08:00.0			19:07:36.5
	4/29	Teleseism (M = 4.9) Revilla Gigedo Islands	14:26:46.5			
	5/1	Local event (sonic boom)	16:03:44.0			16:03:23.2
	5/2	Teleseism (no PDE data)	07:21:57.6			
25		Local event	18:42:03.6			
	5/3	Teleseism (M = 5.4) Northern Chile	07:36:02.5			
		Regional event (M = 3.0) Oklahoma	07:55:32.0			
		Teleseism (M = 5.3) Java	16:41:41.2			
	5/4	Teleseism (M = 5.0) El Salvador	01:14:03.0			
	5/6	Local event (sonic boom)	14:09			
		Teleseism (M = 5.2) Molucca Passage, Indonesia	16:43:47.0			

Table 3 (cont.)

Photo No.	Date	Event Description	Station FMTX	Station NSLM	Station RUSK	Station SMP1
	1982					
	5/7	Teleseism (M = 5.7) Nuclear explosion - Nevada Test Site	18:21:02.5			
	5/10	Teleseism (M = 5.3) Venezuela	01:32:55.8			
		Teleseism (M = 5.2) Molucca Passage, Indonesia	16:43:47.0			
26, 27	5/13	Local event	09:27:47.0 09:27:51.5 (S)			
		Local event	13:14:10.4 13:14:13.5 (S)			
	5/18	Local event (sonic boom)	18:20:17.5			18:19:54.3
	5/22	Teleseism (M = 4.9) Off coast of Central America	12:24:35.0			
	5/23	Teleseism (M = 6.0) Gilbert Islands	21:45:33.0			
	5/29	Teleseism (M = 4.2) Oaxaca, Mexico	02:25:36.0			
		Teleseism (M = 5.2) Northern Chile	03:36:51.5			
		Local event	17:45			
	5/31	Teleseism (M = 5.9) Commander Islands	10:32:23.9			
		Regional event (M = 3.6) Arkansas	17:50:23.0			
		Teleseism Arkansas	18:22:22.2			
	6/1	Teleseism (M = 6.1) Off coast of southern Chile	04:25:56.2			
	6/2	Teleseism (M = 6.4) Tonga Islands	12:50:30.0			
		Local event (sonic boom)	18:26:28.5			
	6/4	Teleseism (M = 5.8) Aleutian Islands	03:11:16.0			
		24 impulsive local events (seismic crew explosions)	16:53 - 19:20			
	6/6	25 impulsive local events	14:45 - 17:44			
		Teleseism (M = 5.2) North Atlantic Ridge	10:29:18.5			
28	6/7	Teleseism (M = 5.9) Guerrero, Mexico	06:56:08.8			06:56:17.0
28		Teleseism (M = 6.0) Guerrero, Mexico	11:03:16.3			11:03:22.5
28		25 local events	15:09 - 18:50			
	6/8	Teleseism (M = 4.7) Guerrero, Mexico	08:05:27.0			
		16 local events	17:19 - 20:30			
	6/9	Teleseism (M = 4.8) Guerrero, Mexico	11:34:20.5			11:34:25.5
		48 local events	14:56 - 23:53			
	6/10	Many small local events	00:00 - 12:00			
		Teleseism (M = 5.2) Chile-Bolivia border	11:52:49.0			
		Local events	13:06 - 19:26			
	6/11	Teleseism (M = 6.3) Tonga Islands	00:51:01.0			00:51:02.5
		Teleseism (M = 5.1) Virgin Islands	22:03:44.0			

Table 3 (cont.)

Photo No.	Date	Event Description	Station FMTX	Station NSLM	Station RUSK	Station SMP1
	1982					
	6/12	Several local events				03:00 - 04:00
	6/14	Teleseism (M = 5.8) Southern Sumatra	17:00:43.7			07:00:45.5
		Teleseism (M = 4.8) Oaxaca, Mexico	22:46:06.8			
	6/16	Local event (sonic boom)	19:04			
	6/22	Teleseism (M = 6.2) Banda Sea	04:36:56.5			
		Local event (sonic boom)	18:07			08:06
	6/23	Small local events	18:00 - 23:00			
	6/24	Teleseism (M = 5.6) Southern Nevada	14:19:21.7			
	6/25	Teleseism (M = 5.3) Southwest of Sumatra	10:43:41.0			
	6/27	Teleseism (M = 4.8) Caribbean Sea	01:14:47.0			
	6/29	Local event (sonic boom)	18:06			18:05
		Regional event (M = 4.6) Veracruz, Mexico	22:39:39.4			22:39:41.9
	7/1	Teleseism (M = 6.6) Kuril Islands	02:09:59.5			02:10:03.0
	7/2	Teleseism (M = 5.0) Off coast of Central America	12:03:59.0			
		Teleseism (no PDE data)	01:01:33.5			
		Teleseism (M = 6.2) Nuclear explosion - Eastern Kazakh, U.S.S.R.	01:30:56.6			
		Teleseism (M = 4.5) Guerrero, Mexico	03:13:22.5			03:13:37.5
		Teleseism (M = 5.5) Northern Colombia	06:22:31.9			06:22:33.0
	7/5	Regional event (M = 3.8) Arkansas	04:14:52.4			04:14:51.9
		Teleseism (M = 4.6) Guatemala	16:19:04.5			
	7/7	Teleseism (M = 5.2) Off coast of Nicaragua	01:57:28.6			01:57:31.0
		Local event (sonic boom)	19:10			19:10
	7/8	Teleseism (M = 4.9) Baja California	15:45:01.5			
	7/11	Teleseism (M = 5.4) Off shore of Peru	02:22:49.5			
		Teleseism (M = 5.2) Natural Ridge	10:48:27.5			
		Teleseism (M = 4.9) Baja California	18:06:05.5			
	7/12	Impulsive local events	20:00 - 02:00			
	7/14	Teleseism (M = 4.9) Southern Alaska	12:24:10.2			
	7/15	Teleseism (M = 5.6) Gilbert Islands	02:26:46.5			
	7/19	Local event (sonic boom)	14:42			
		Small impulsive local events	15:00 - 16:00			
	7/25	Local event (thunderstorm)	15:00 - 24:00			
	7/26	Teleseism (no PDE data)	18:10:53.8			
	7/28	Local event (sonic boom)	13:43			14:42

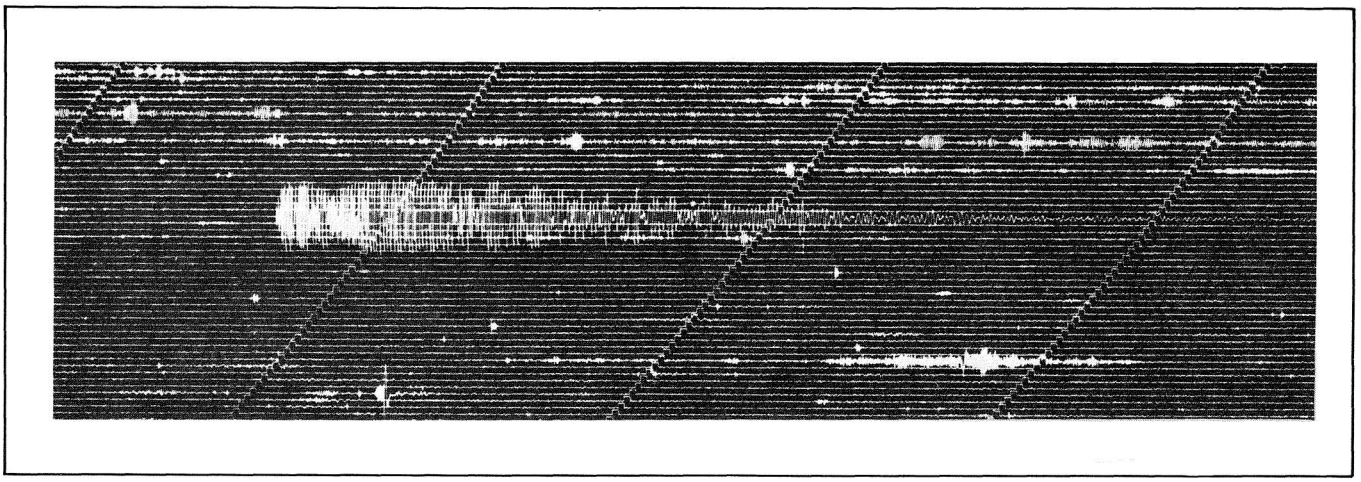
Table 3 (cont.)

Photo No.	Date	Event Description	Station FMTX	Station NSLM	Station RUSK	Station SMP1
	1982					
	7/31	Teleseism (M = 6.2) Rat Islands	06:39:55.3			
	8/1	Local event (seismic crew explosion?)	23:36:25.0			
	8/2	Series of small impulsive local events (caused by animals?)	05:00			
	8/3	Several local events	00:28 00:55 16:26 17:17			
		Local events (many impulsive signals)	03:00 - 06:00 17:48 17:56 18:05 20:46 20:56 21:31 21:41 21:51 21:56 21:59 22:02 22:05 22:09 22:13 22:28 22:31 22:44 22:51 22:54			
29	8/4	Local event (sonic boom)	14:23			
	8/5	Teleseism (M = 5.4) Northern Chile	09:27:03.0			09:27:03.55
		Teleseism (M = 5.7) Nuclear explosion - Nevada Test Site	14:04:16.7			14:04:16.0
	8/6	Teleseism (M = 5.4) Aleutian Islands	05:04:04.3			05:04:03.8
30		Local events (seismic crew explosions?)	18:09 18:16 20:05 20:16 20:39 21:01 21:08 21:16 21:37 21:44 22:26			21:08:41.0 (P) 45.0 (S) 21:16:23.5 (P) 27.5 (S) 21:37:19.0 (P) 23.2 (S) 21:44:58.5 (P) 62.5 (S) 22:26
	8/7	Teleseism (M = 6.1) South of Bali	21:16:00.5			21:16:01.5
31		Local events (seismic crew explosions?)	18:15 18:23 18:45 18:57 19:05			18:15:55.5 (P) 59.0 (S) 18:23:25.5 (P) 29.0 (S) 18:45 18:57:57.5 (P) 60.5 (S) 19:05:54.9 (P) 58.0 (S)

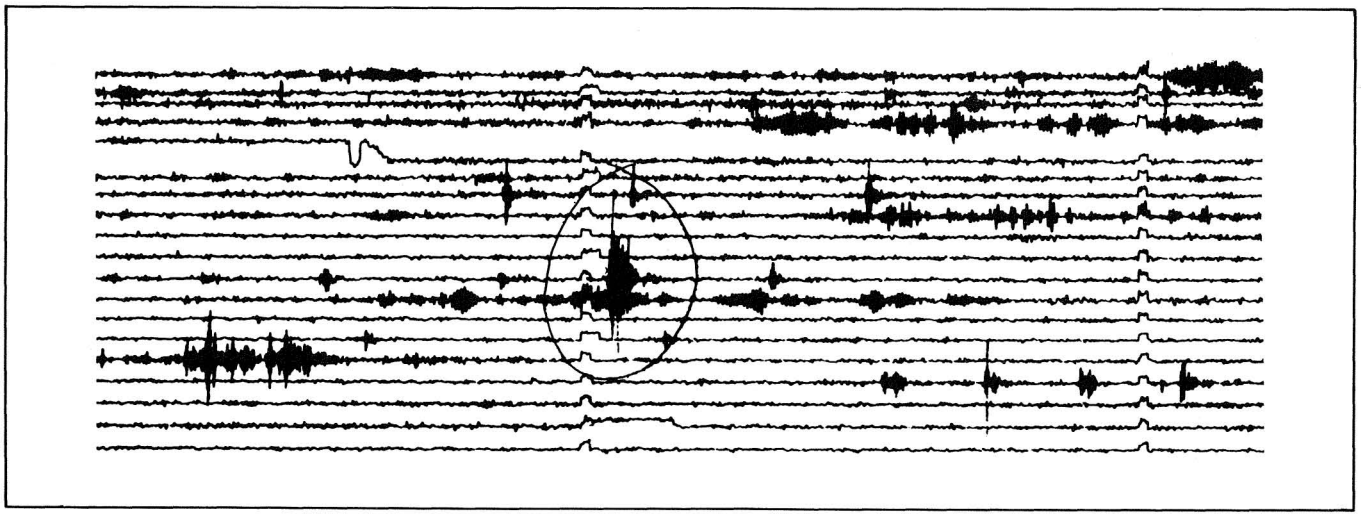
Table 3 (cont.)

Photo No.	Date	Event Description	Station FMTX	Station NSLM	Station RUSK	Station SMP1
	1982					
			19:18			19:18
			19:36			19:36
			19:48			19:48:23.8 (P)
						27.2 (S)
			19:56			19:57
			20:04			20:04
			20:13			
			20:33			20:33
			21:55			21:55
			22:08			22:08
			22:50			22:50
			22:59			22:59
			23:07			23:07:44.6 (P)
						48.0 (S)
			23:14			23:14:09.7 (P)
						13.0 (S)
	8/8	Teleseism (M = 5.4) Kamchatka Peninsula	06:25:46.5			
		Small local events	14:00 - 17:00			
	8/9	Teleseism (M = 3.2) Arkansas	11:13:33.5			11:13:33.5
		5 small local events	21:50			
	8/10	Teleseism (M = 5.5) Northern Peru	04:59:27.0			04:59:28.5
		Teleseism (M = 4.9) South Pacific	07:32:18.0			
		Local event (sonic boom)	14:08			14:08
	8/14	Teleseism (M = 5.2) Solomon Islands	05:50:33.0			
		Small impulsive local events (caused by animals?)	17:23 - 22:00			
32	8/15	Small impulsive local events	08:00 - 10:00 20:00 - 24:00			
		Teleseism (M = 5.4) Peru	06:19:25.3			
	8/16	Teleseism (M = 4.7) Guerrero, Mexico	05:15:46.5			
		Teleseism (M = 5.0) Guatemala	06:37:02.0			
33	8/17	Local event	06:37:33.0			
		Local event (sonic boom)	14:58			14:58
		Teleseism (M = 6.0) Mediterranean region	22:35:34.0			22:35:35.0
	8/18	Teleseism (M = 4.9) Jalisco, Mexico	04:02:14.2			04:02:20.0
	8/19	Teleseism (M = 6.3) South of Panama	16:04:48.8			
	8/20	Teleseism (M = 5.3) Guatemala	21:32:13.0			21:32:14.3
	8/24	Teleseism (M = 5.3) Fox Islands	04:19:37.8			
	8/26	Teleseism (M = 5.8) Ecuador	05:30:06.0			
		Local event (sonic boom)	15:08			
	8/29	Teleseism (M = 5.7) Java	13:36:44.6			13:36:44.4
	8/30	Teleseism (no PDE data)	01:44:35.4			
		Teleseism (M = 4.9) Guerrero, Mexico	02:52:48.0			

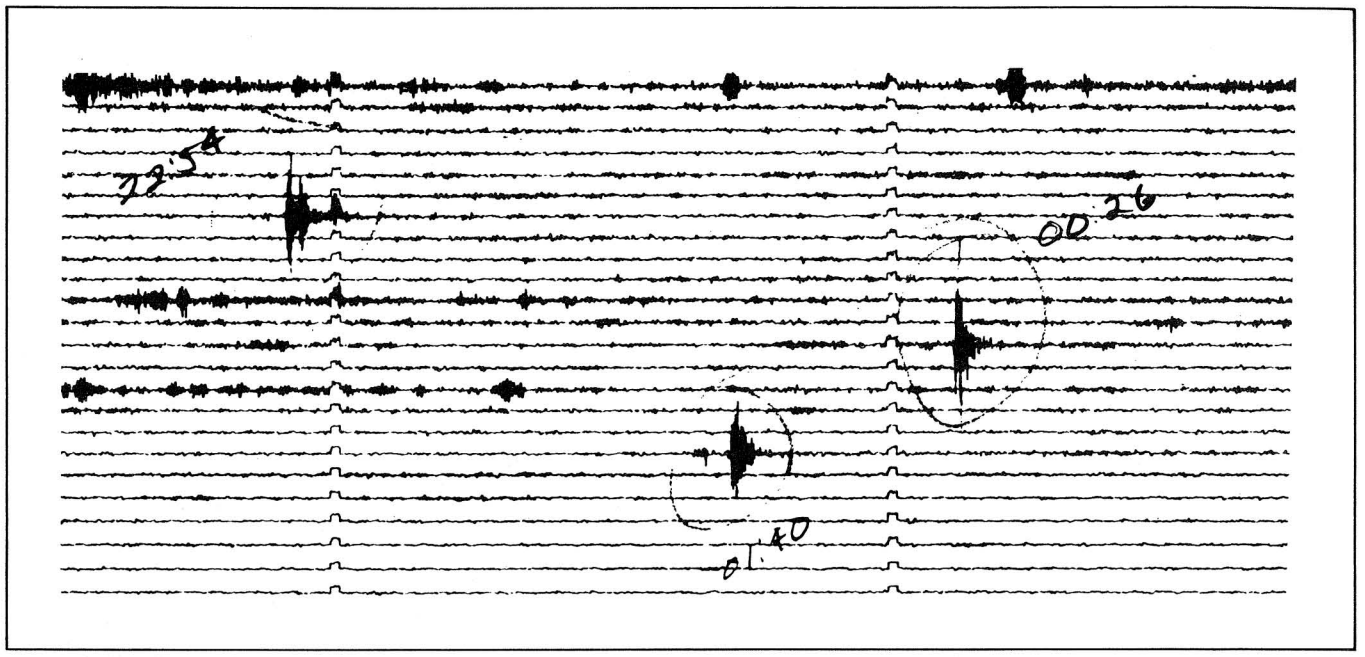
Figure 10. Photographs of 33 parts of seismograms recorded by the East Texas Seismic Network. Photographs are described in accompanying captions. Numbering of photographs corresponds to numbers shown in table 3 (photograph 1 was obtained before the network was operational and is not cited in table 3). Time marks (repeated offsets) are 1 minute apart. Additional time scales are indicated on figures lacking two rows of time marks.



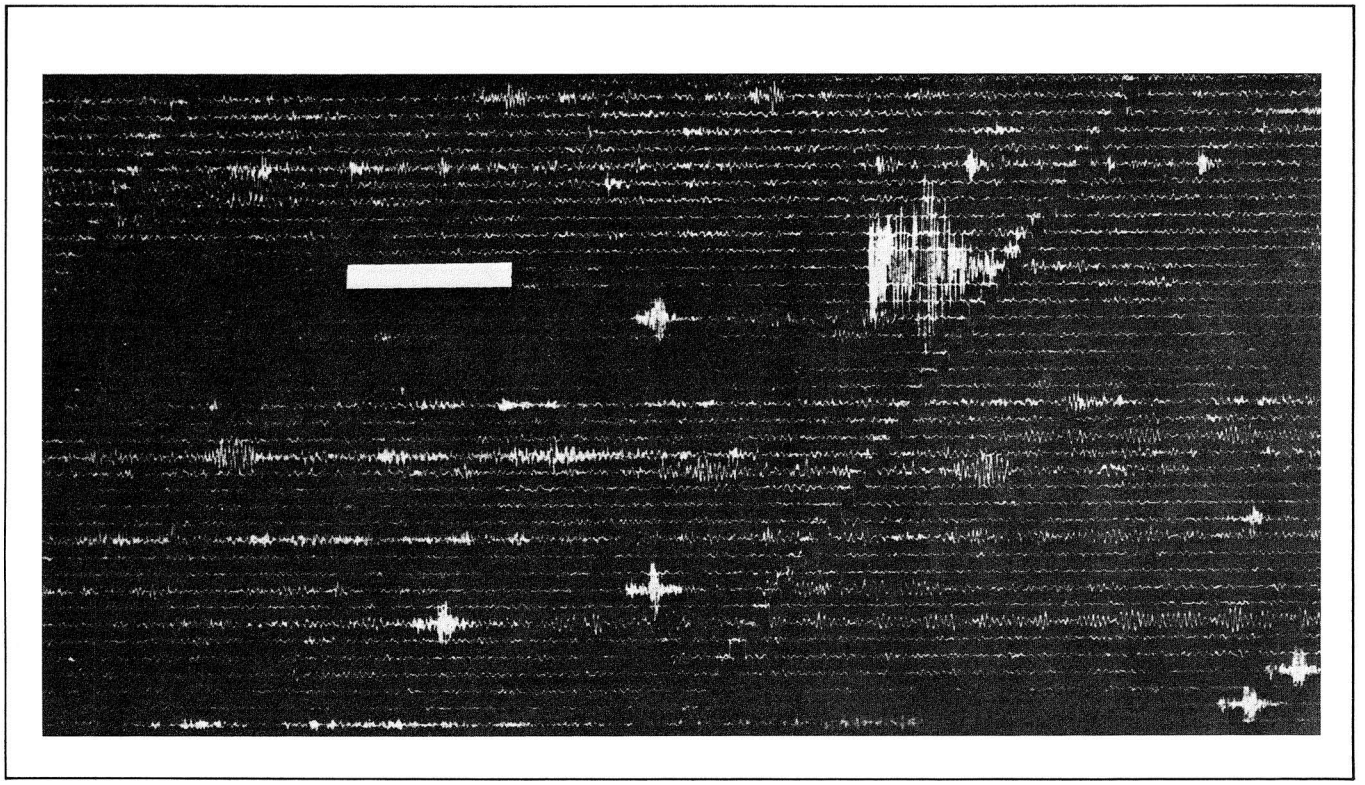
Photograph 1. The Center, Texas, earthquake recorded at SMP1.



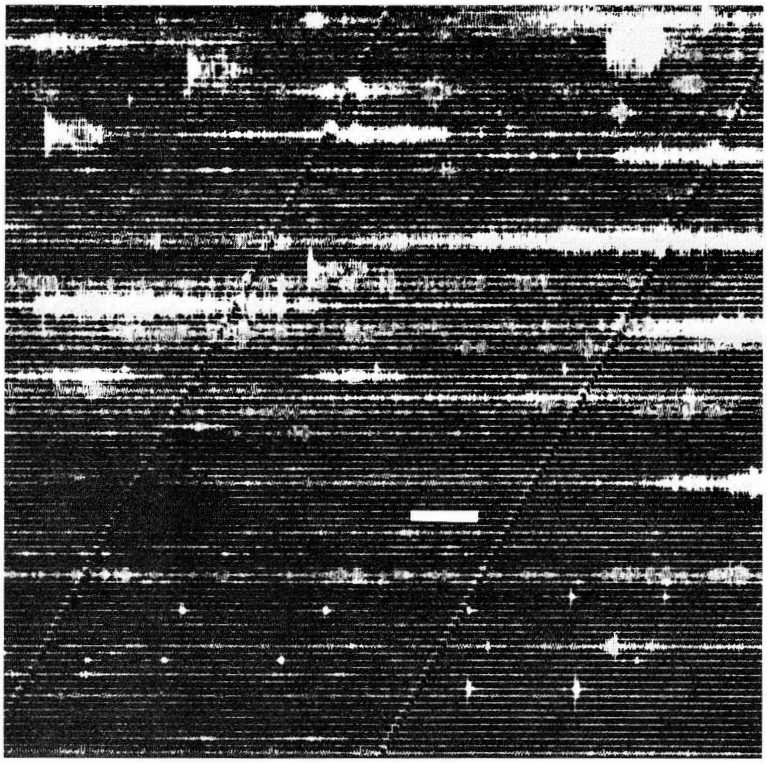
Photograph 2. Local impulsive events of undetermined origin recorded at FMTX; circled event is listed in table 3. Some sequences include several events per minute.



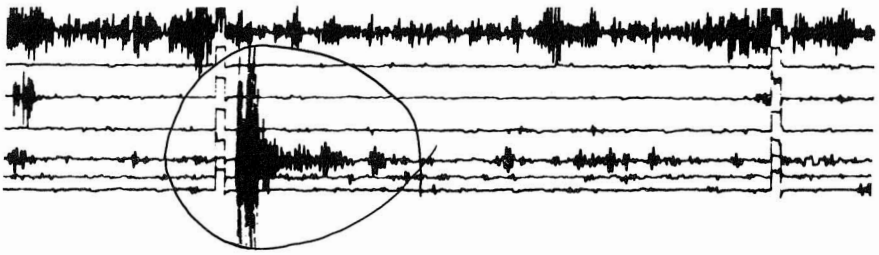
Photograph 3. Three local events recorded at FMTX. These events were observed at other stations in the network. The large-amplitude phase exhibits an apparent velocity of less than 400 m/s. These phases are apparently surface waves from events of unknown origin (possibly explosions) outside the network to the southeast.



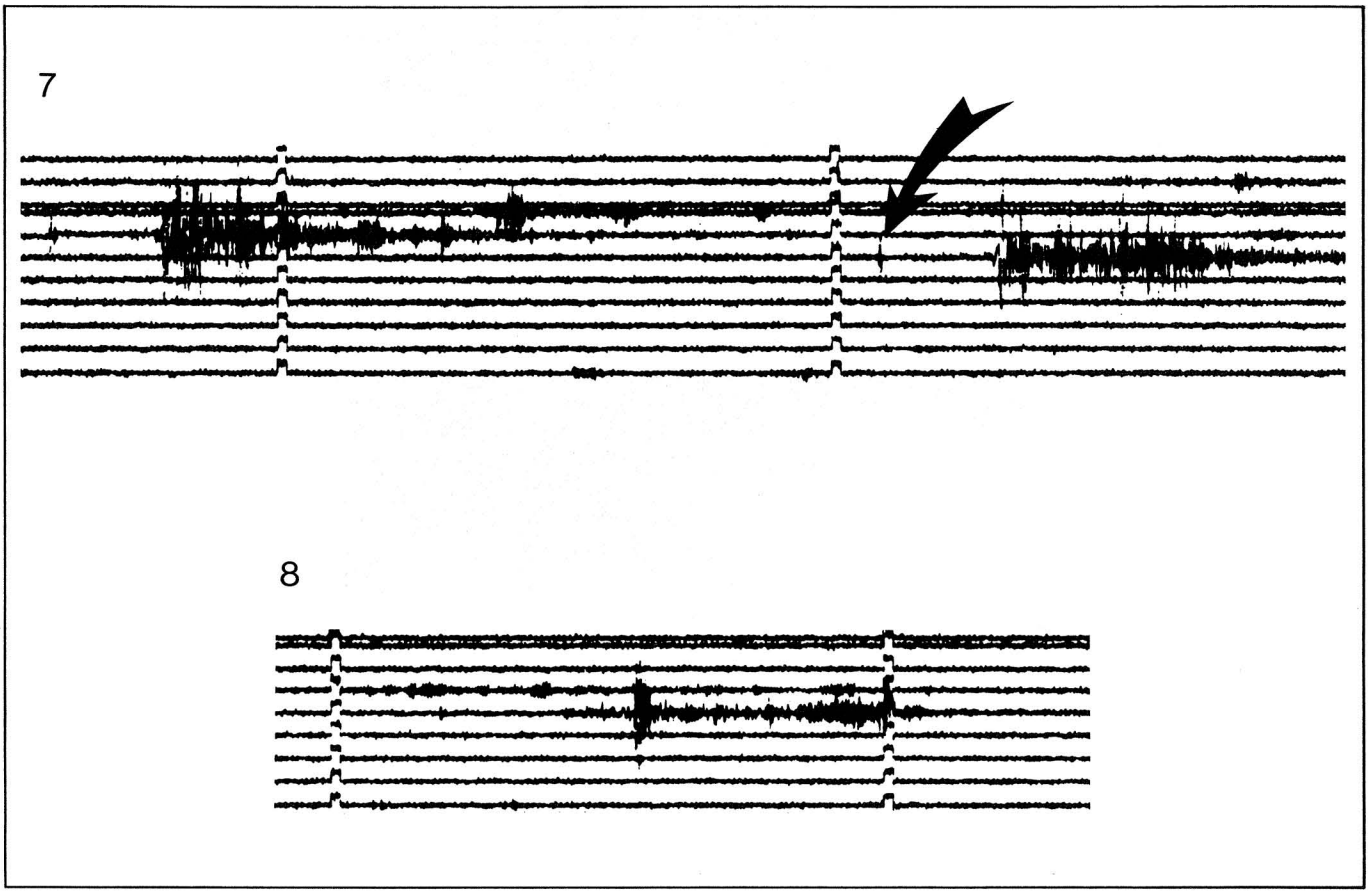
Photograph 4. Many events of local origin recorded at SMP1. The white bar is 10 seconds long.



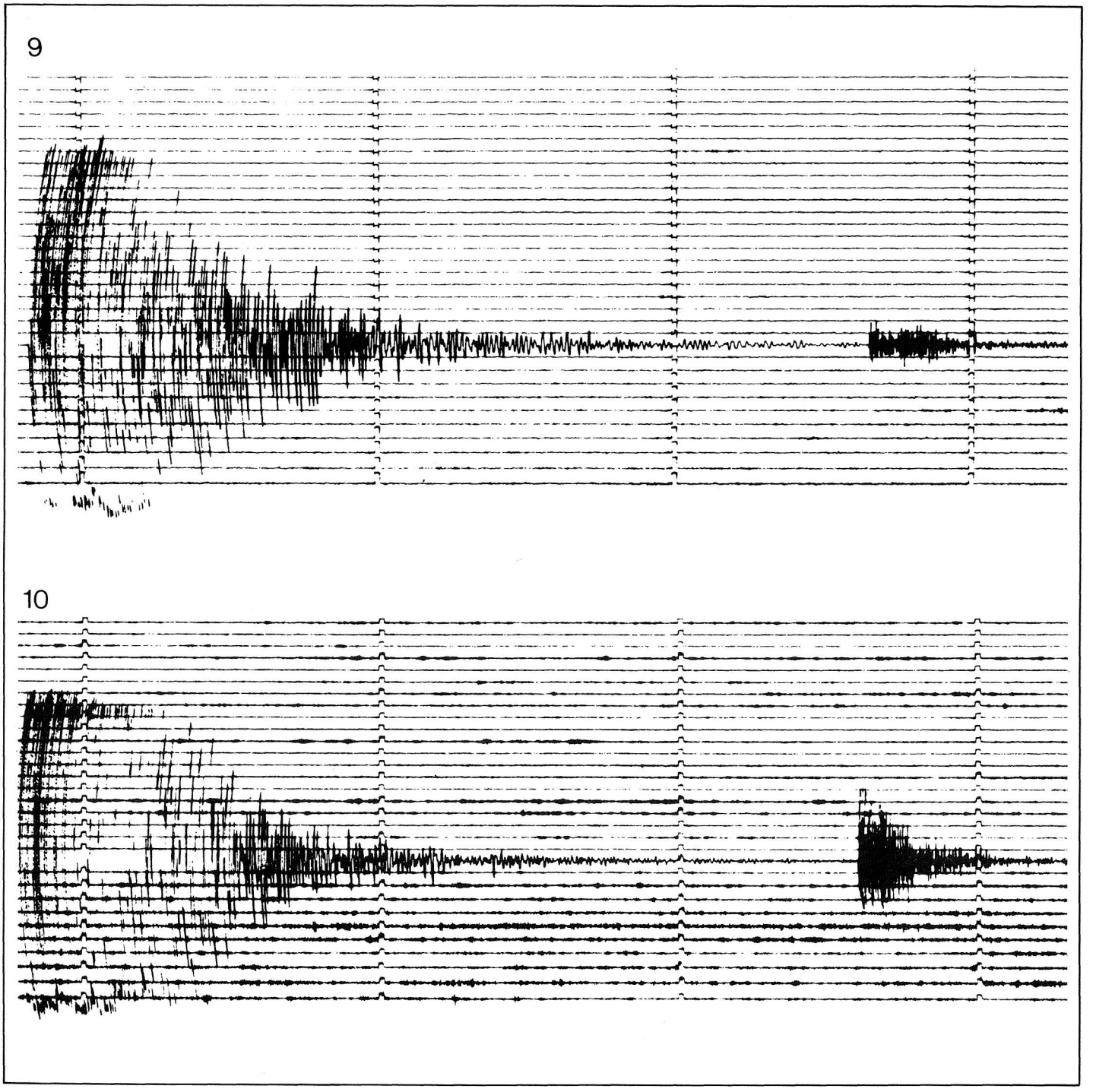
Photograph 5. Large impulsive events in daytime (top of photo) and small impulsive events at night. This sequence is commonly observed and seems unlikely to be caused by explosions. The origin of the events is unknown. Bar in photograph is 10 seconds long.



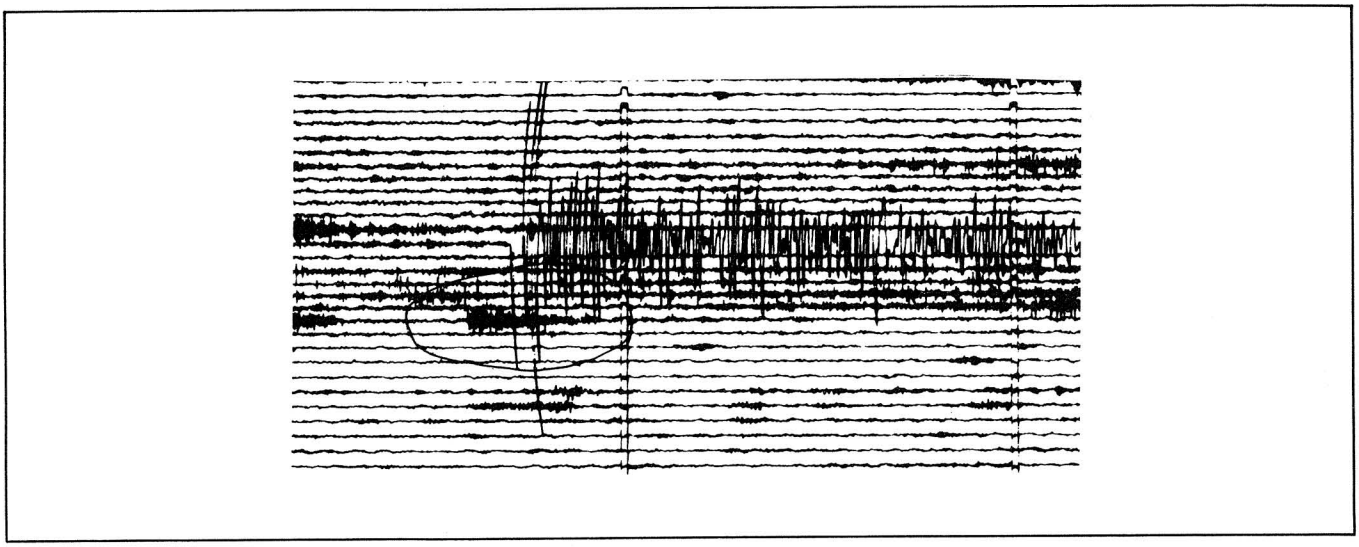
Photograph 6. One of several local events recorded at FMTX. Origin unknown.



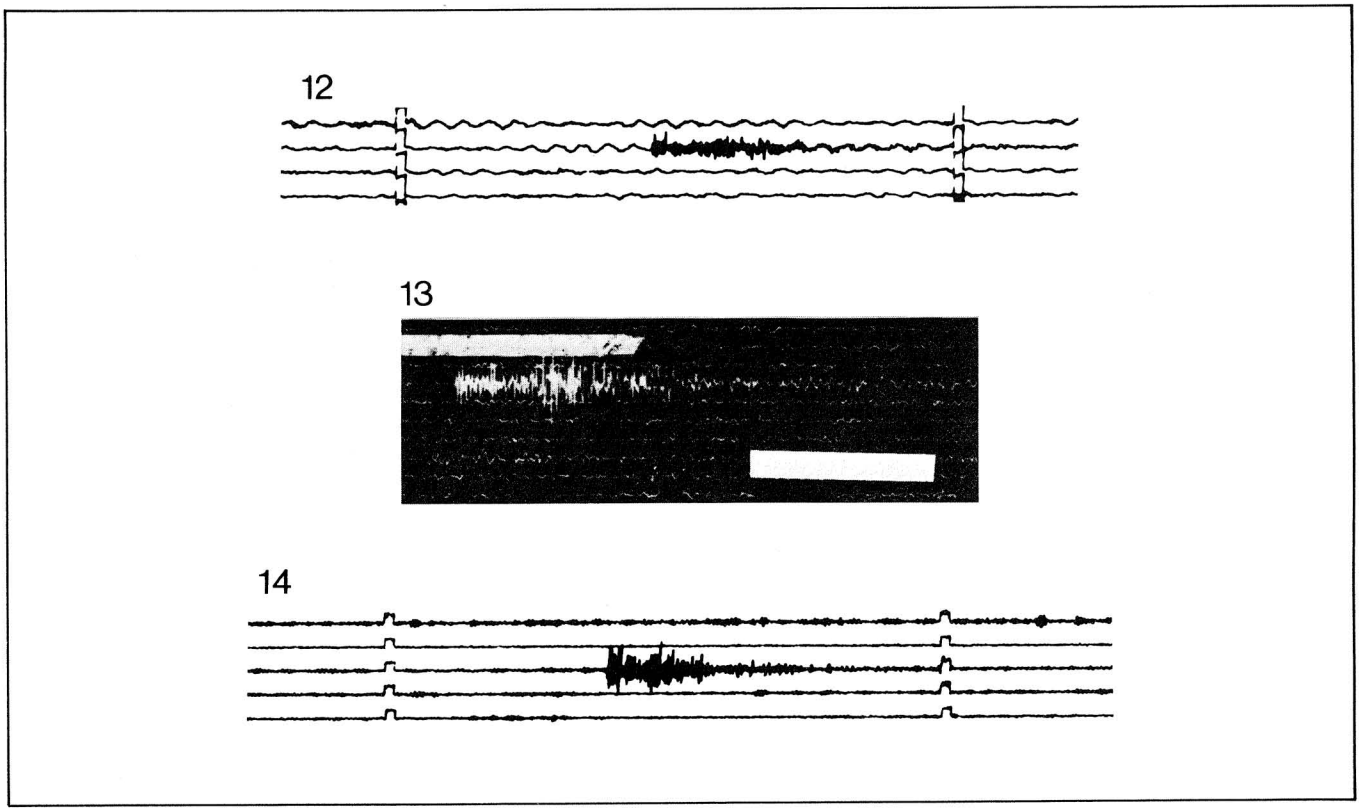
Photographs 7 and 8. Thunder recorded at FMTX and NSLM, respectively. The sharp, impulsive phase preceding the thunder (see arrow in photograph 7 for one example) is probably radio interference caused by the lightning bolt.



Photographs 9 and 10. The Jacksonville earthquake and first aftershock recorded at RUSK (photograph 9) and FMTX (photograph 10).



Photograph 11. Possible local event recorded at FMTX (circled). This may be an aftershock of the Jacksonville event but was not recorded by other stations. Larger event seven lines above and to the right of local event is a teleseismic arrival from an earthquake in Guatemala.



Photographs 12, 13, and 14. A Jacksonville aftershock recorded at FMTX, NSLM (smoked-paper recorder temporarily deployed at site), and RUSK, respectively. Lower bar on NSLM is 10 seconds long.

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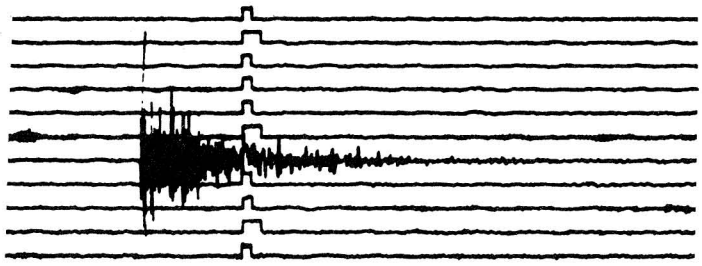

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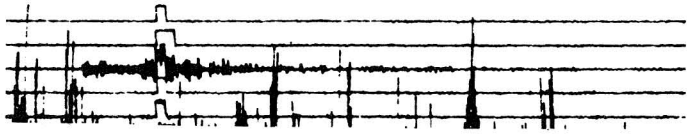
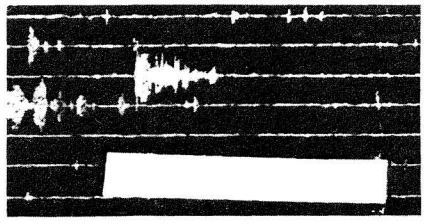
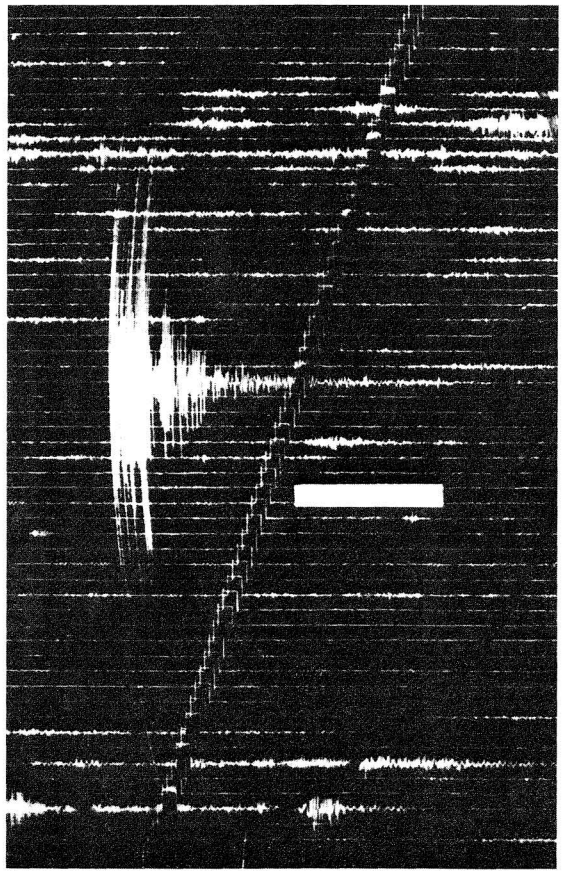


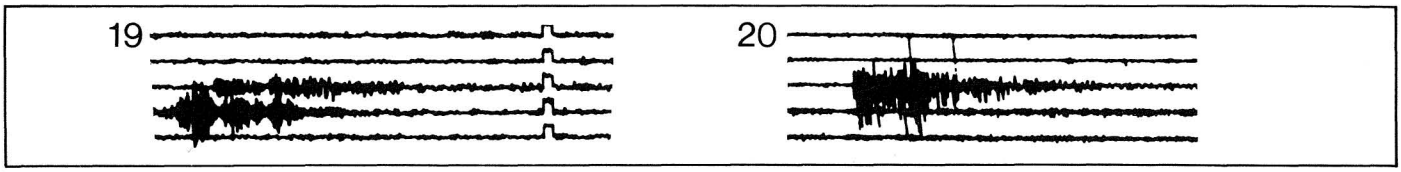
17



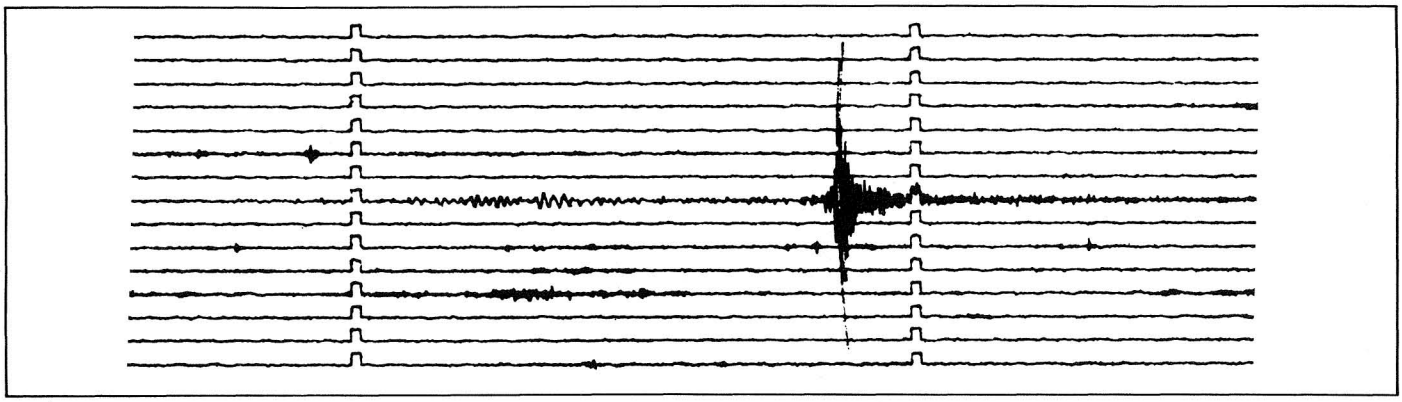
18



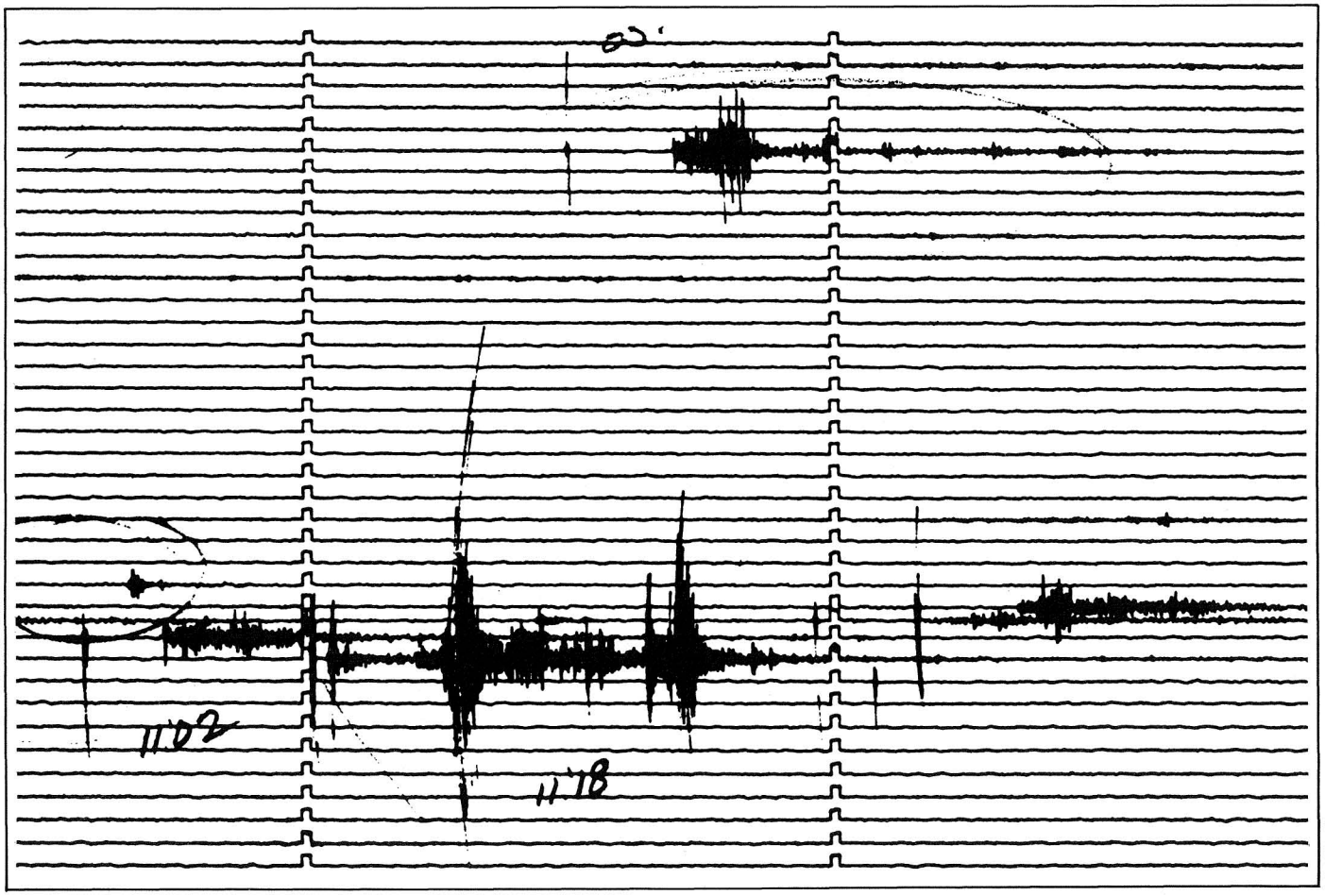
Photographs 15, 16, 17, and 18. Mount Enterprise earthquake recorded at FMTX, RUSK, SMP1 and SMP3, respectively. Time scale for FMTX and RUSK is same as in photographs 12 and 14. White bars on SMP1 and SMP3 are both 10 seconds long (photographs are magnified by different amounts).



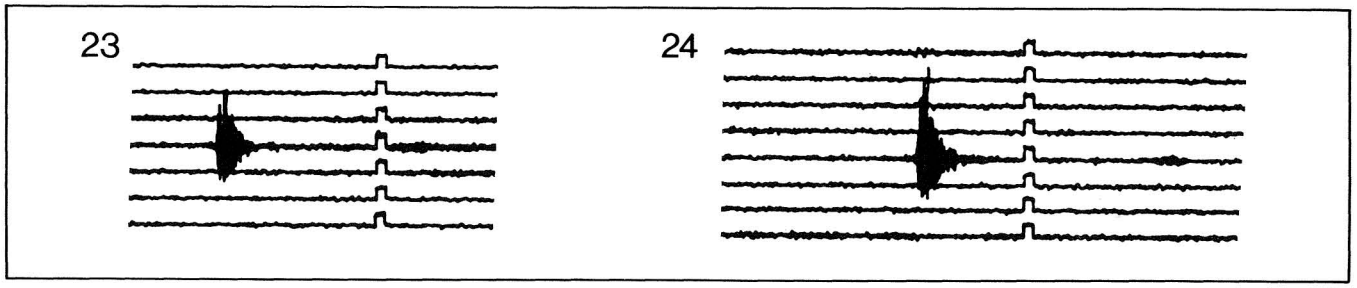
Photographs 19 and 20. Jacksonville aftershock recorded at FMTX (upper trace, fig. 19) and RUSK (fig. 20). Time scale is the same as in photographs 21 and 22.



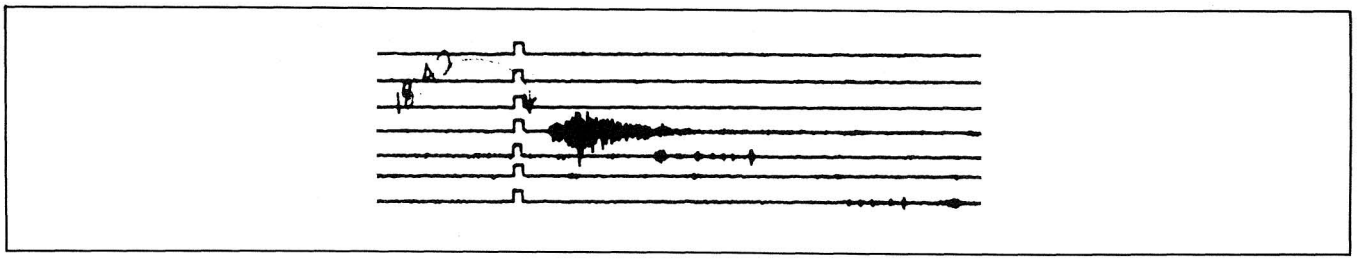
Photograph 21. Presumed sonic boom recorded at FMTX. The large-amplitude high-frequency phase is the air phase; the lower amplitude, lower frequency emergent arrival preceding the air phase is apparently an air-coupled phase in the ground. Similar events are recorded frequently.



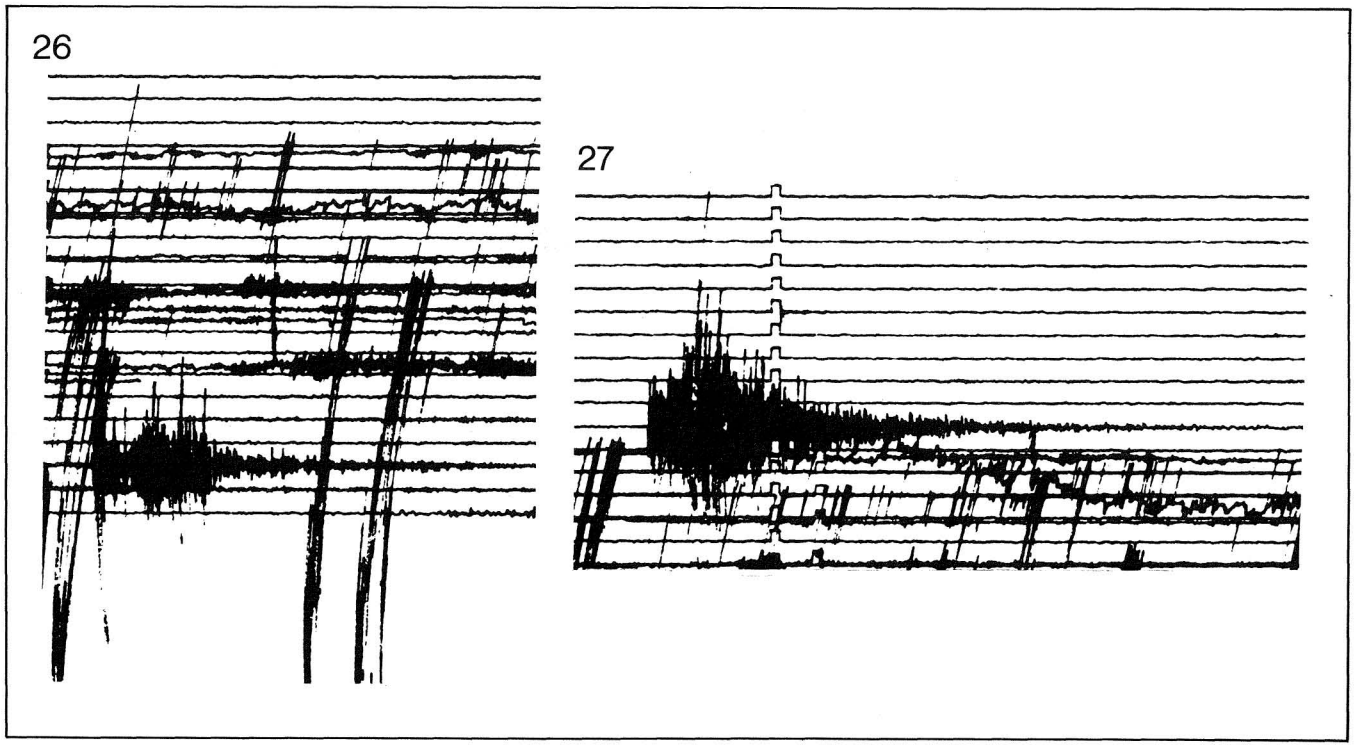
Photograph 22. Probable thunderstorms recorded at FMTX. High-frequency impulsive arrivals appear to be caused by radio interference from lightning preceding the arrival of thunder.



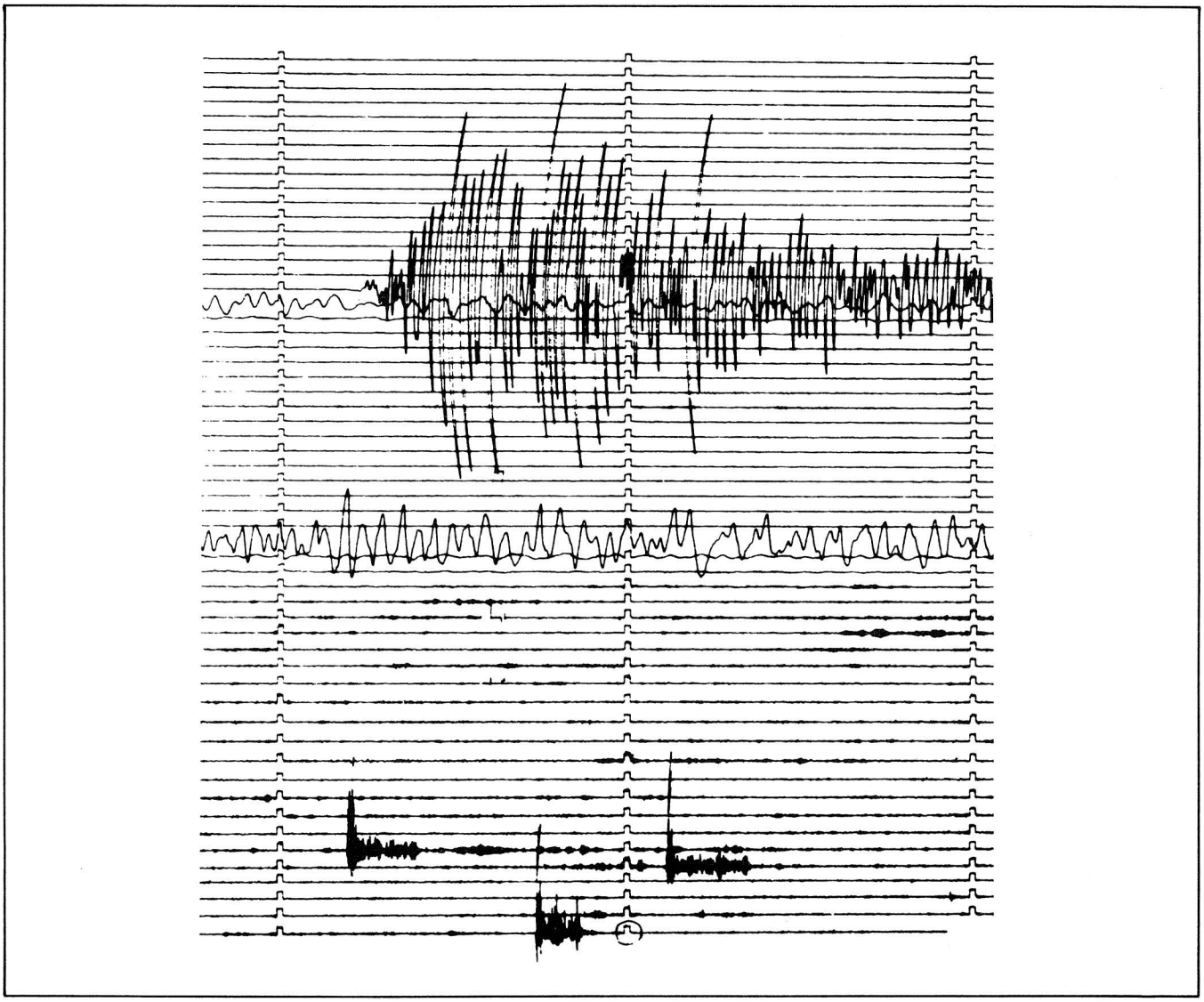
Photographs 23 and 24. Two events of undetermined origin recorded at FMTX. Time scale is the same as in photograph 21.



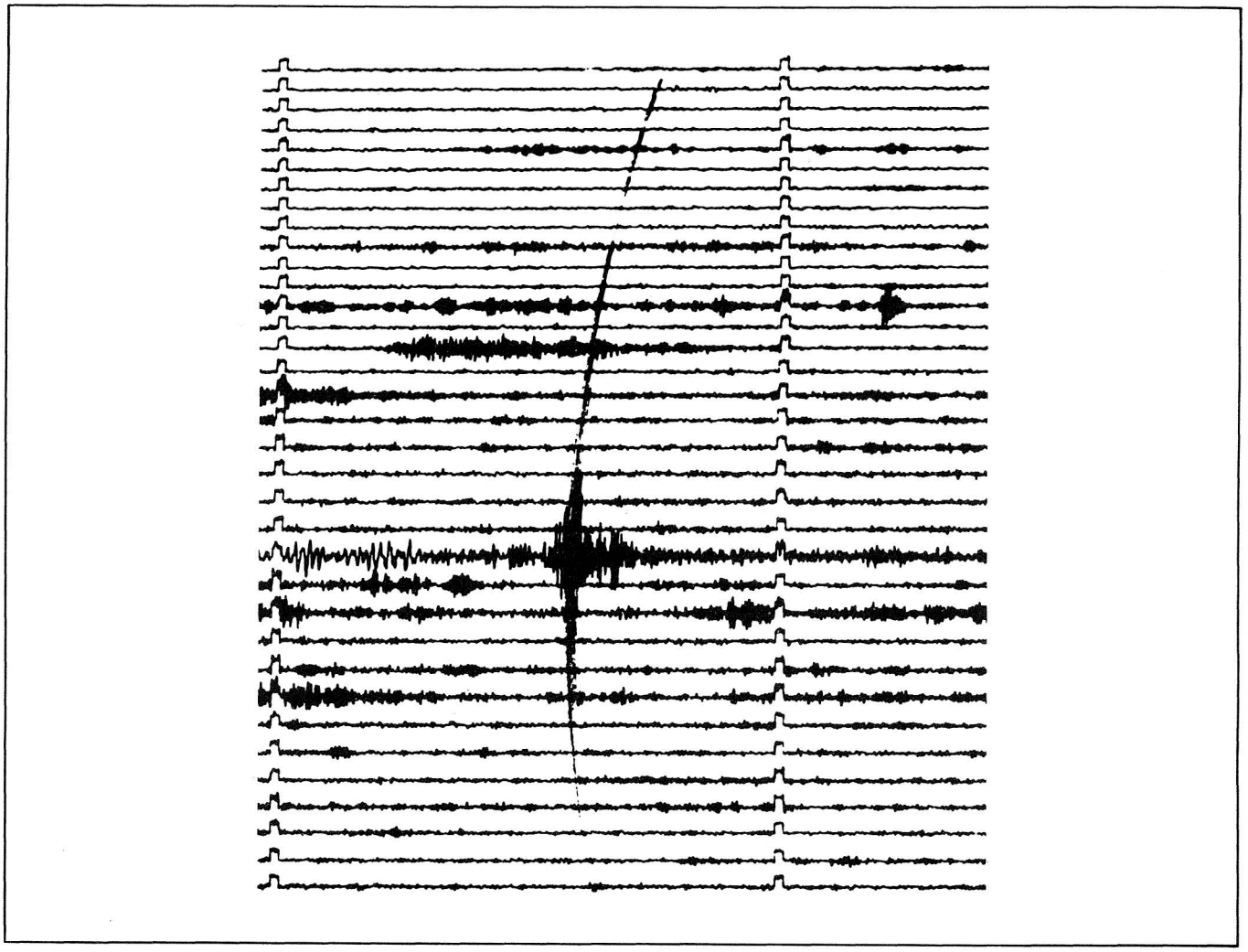
Photograph 25. Event of undetermined origin recorded at FMTX. Time scale is the same as in photograph 21.



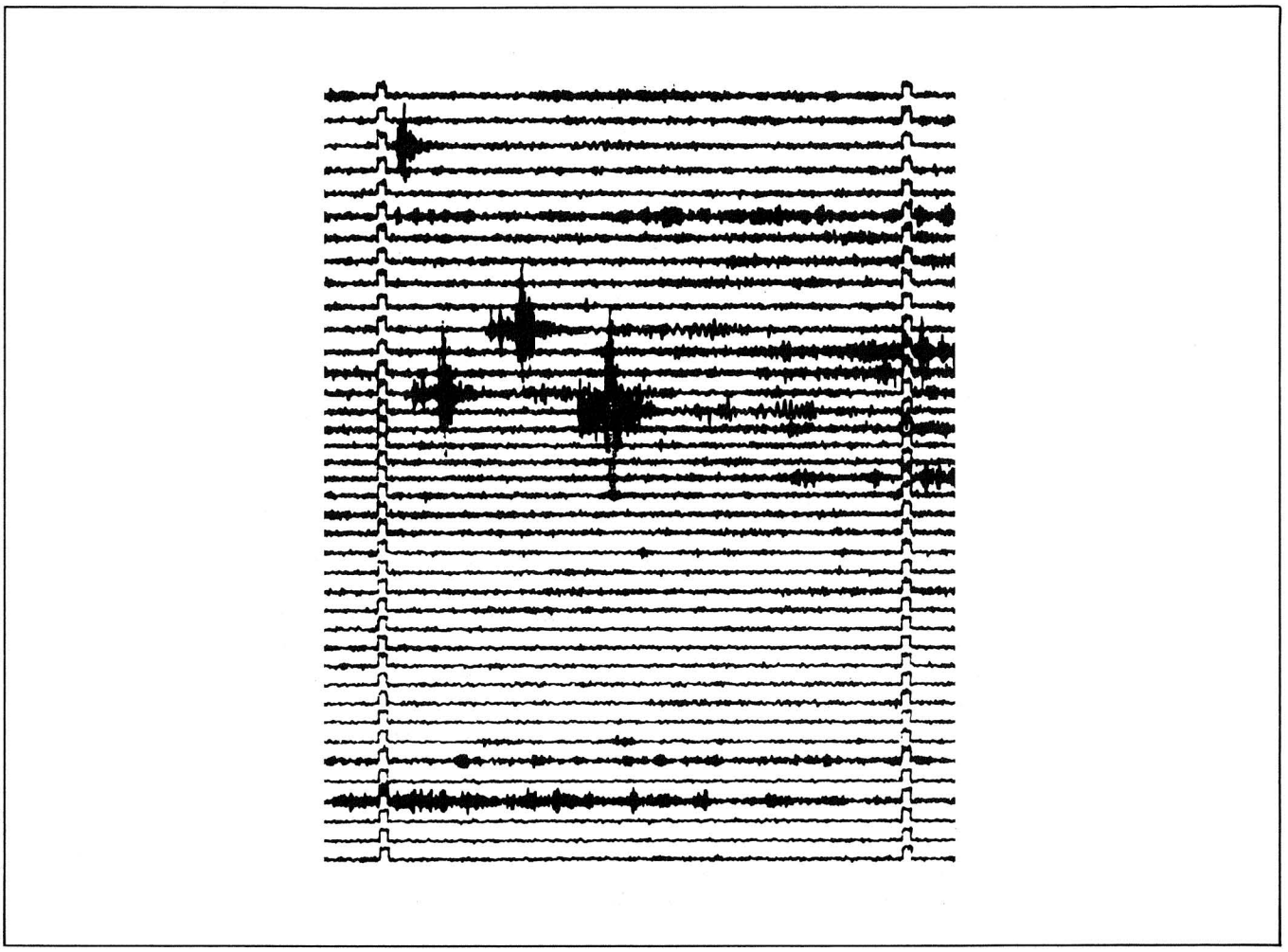
Photographs 26 and 27. Two events presumed to be earthquakes, recorded at FMTX. Noise is radio interference. P-to-S intervals of 3.1 to 4.5 seconds correspond to epicentral distances of 25 to 36 km from FMTX. Time scales are the same as in photograph 21.



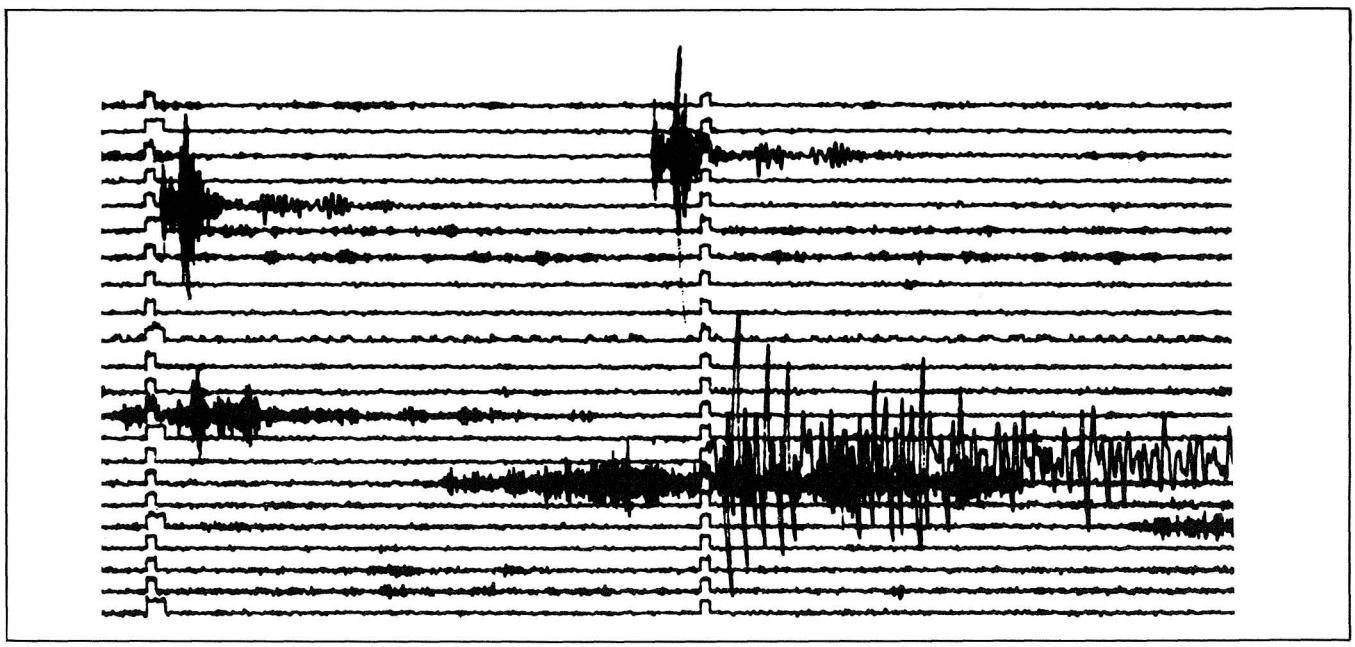
Photograph 28. Teleseismic (distant) and local events recorded at FMTX. Uppermost event is P arrival from magnitude 5.9 earthquake in southern Mexico. Central event is part of the coda of another Mexican event. Lowermost three events are part of a series of 25 events of unknown origin. Circuitry that prevents the pens from swinging over the edge of the drum is responsible for the one-sided appearance of these events of unknown origin.



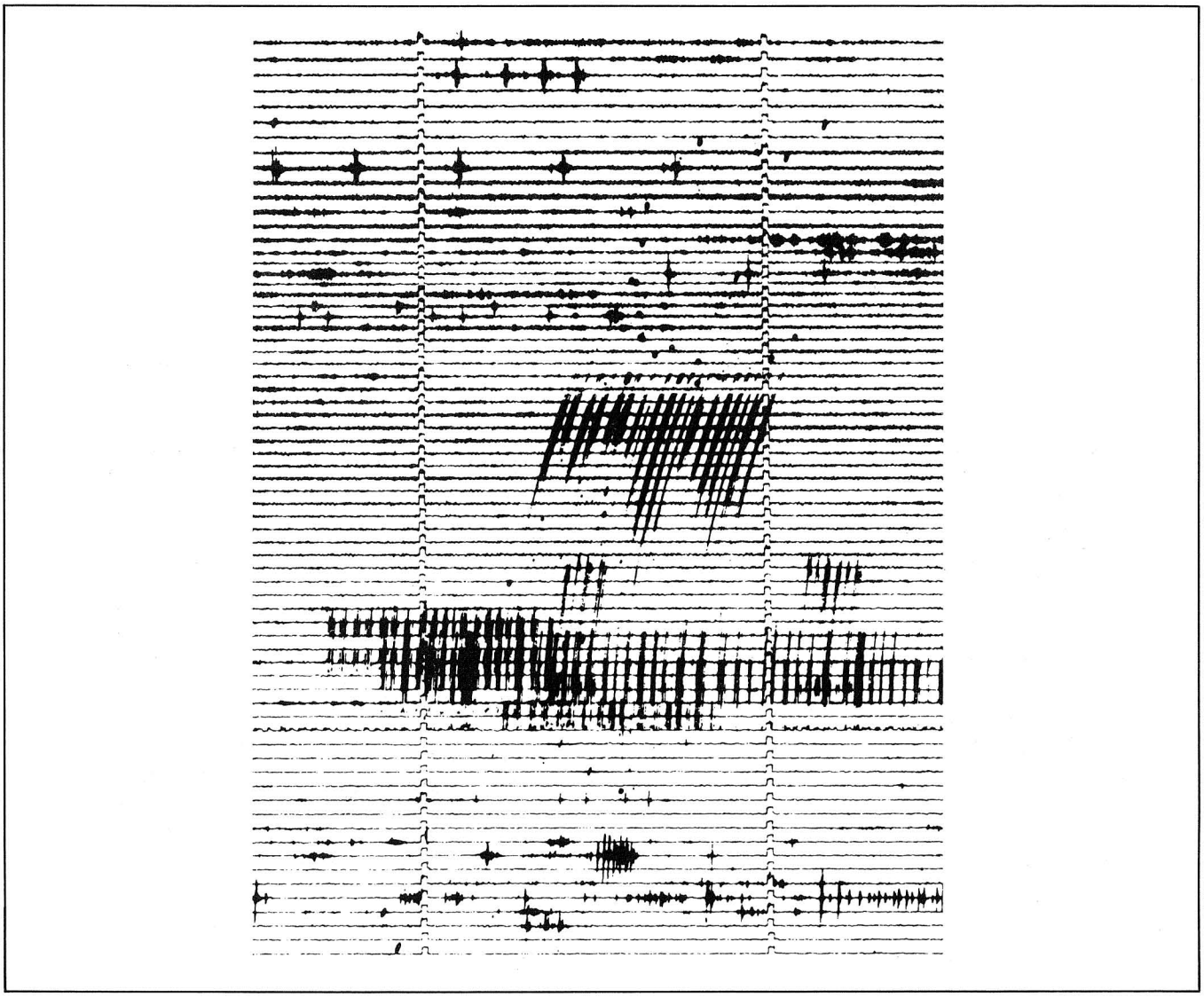
Photograph 29. Sonic boom (large-amplitude event in center of figure) recorded at FMTX.



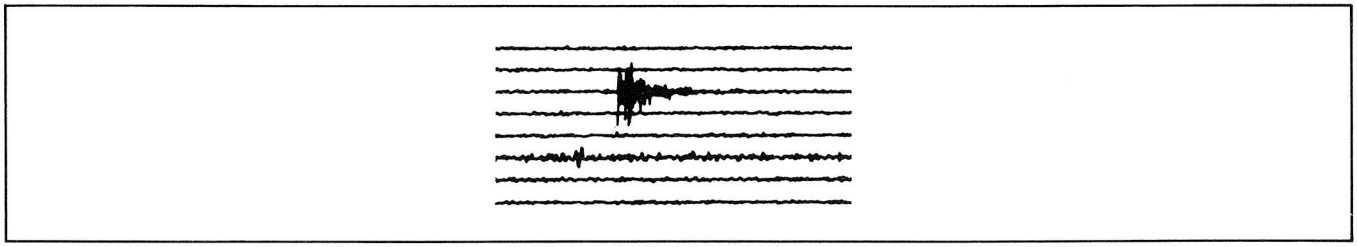
Photograph 30. Local events of unknown origin recorded at FMTX. Initial arrivals are P waves; large-amplitude arrivals are S waves. Long-period, low-amplitude surface waves can be seen following the S waves by 20 seconds. Part of a series of 11 events.



Photograph 31. Local events of unknown origin recorded at FMTX on the day following the events of photograph 30. The P-to-S time and S-to-surface-wave time have shortened, indicating the sources are closer to FMTX than those of the day before. Events of both days occurred between noon and 4:30 p.m. CDT and were no doubt caused by human action. They are probably explosions used for seismic exploration. The long-period event at lower right is an earthquake near Bali, Indonesia. The emergent high-frequency events beneath that are from nearby automobiles or trucks.



Photograph 32. Some of the types of local events most difficult to explain on part of a seismogram recorded at FMTX over a period of 18 hours. On the top part are several sequences of events, some of which occur at irregular but frequent intervals. Note that up to four events may occur within 30 seconds. The regular noise in the central part is from radio interference. The small, frequent, and highly irregular events in the lower part of the seismogram occurred at night.



Photograph 33. A local event of unknown origin recorded at FMTX. Time scale is the same as in photograph 31.