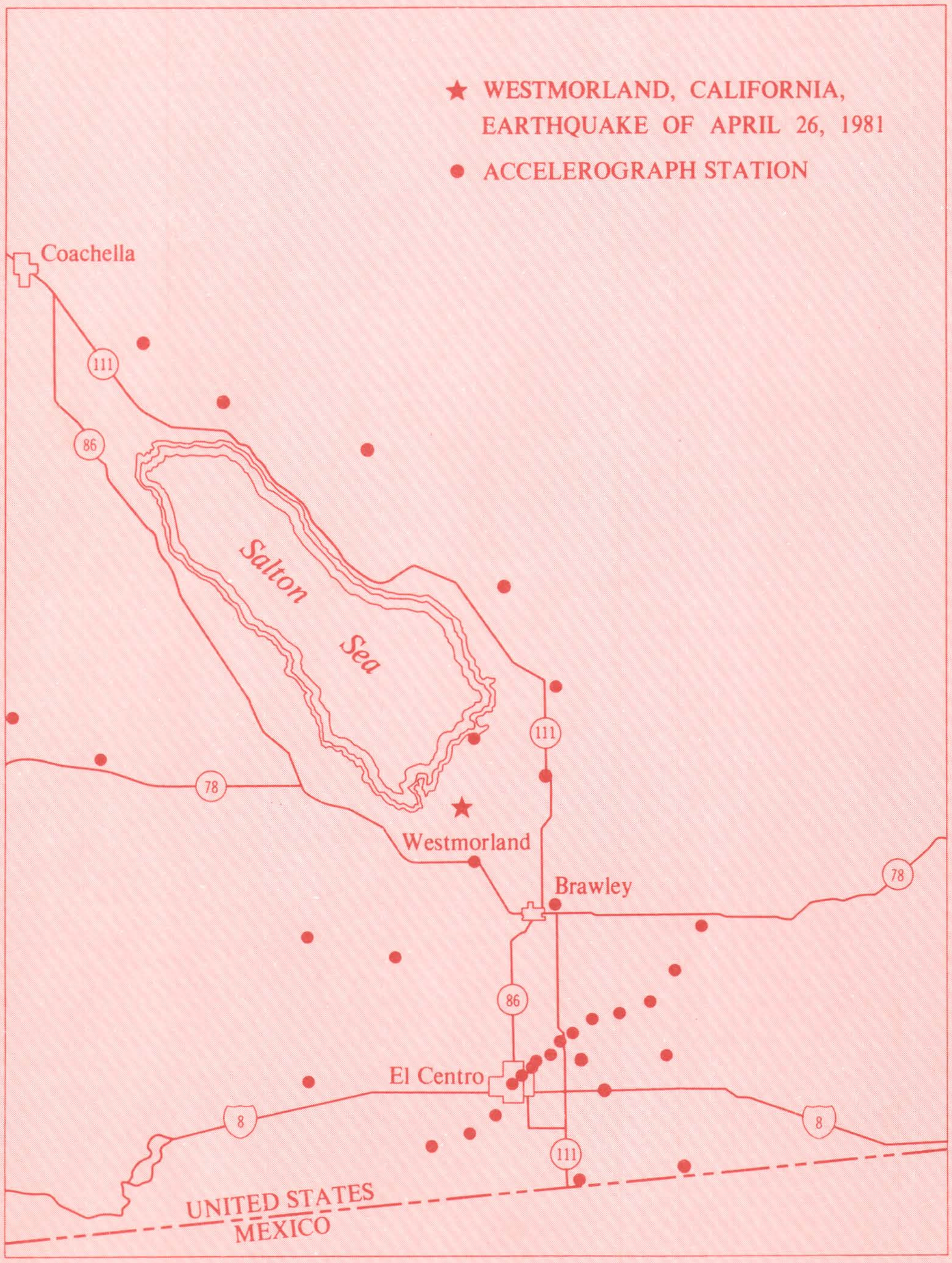
CIRC 914

STRONG-MOTION PROGRAM REPORT, JANUARY-DECEMBER 1981



GEOLOGICAL SURVEY CIRCULAR 914

Strong-Motion Program Report, January - December 1981

GEOLOGICAL SURVEY CIRCULAR 914

1983

United States Department of the Interior
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PREFACE

This Strong-Motion Program report gives preliminary information on the nature and availability of strong-motion data recorded by the U.S. Geological Survey (USGS). The program is operated by the USGS in cooperation with numerous Federal, State, and local agencies and private organizations. Major objectives of the program are to record both strong ground motion and the response of various types of engineered structures during earthquakes and to disseminate this information and data to the international earthquake-engineering research and design community.

This report contains a summary of the accelerograms recovered from the USGS National Strong-Motion Network during the year 1981. A brief summary of USGS strong-motion data recorded during the Westmorland, California, earthquake of April 26, 1981, and a revision of strong-motion data recorded during the Livermore, California, earthquakes of January 24 and 26, 1980, are included along with summaries of recent strong-motion reports, notes on the availability of digitized data, and additional general information related to the USGS and to other strong-motion programs. The data summary in table 1 contains information on those accelerograms recovered (although not necessarily recorded) during 1981.

Ronald L. Porcella, Editor
U.S. Geological Survey, Mail Stop 77
Menlo Park, California 94025

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1981 STRONG-MOTION RECORDS

By J. C. Switzer

During 1981 there were 125 records recovered from the USGS National Strong-Motion Network, compared with a yearly average of 227 records for the period 1972 to 1980 inclusive. The most significant record set obtained in 1981 was recorded during the magnitude 5.6 earthquake on April 26 near Westmorland in the Imperial Valley, California. This earthquake triggered accelerographs at 24 USGS stations in the region and produced significant ground accelerations at the Brawley, Salton Sea, Parachute Test, and Superstition Mountain stations (see the following report).

The USGS Hawaii strong-motion network produced 25 records during 1981; this brings the total number of accelerograph records to more than 100 since the network was first established in February 1973. Two strong-motion stations on Mauna Loa and Mauna Kea were triggered and produced the first records from those stations since their installations in 1979 and 1980, respectively. The most significant acceleration was recorded at the Molokai Airport station during a magnitude 5.5 earthquake on March 5, 1981; the maximum horizontal acceleration was 0.19 g with a strong duration (acceleration greater than 0.10 g) of 0.3 second (see table 1, end of report).

Many of the additional records recovered in 1981 (table 1) are related to small-magnitude earthquakes near Bear Valley, in central California, and near Anchorage, in south-central Alaska.

THE WESTMORLAND, CALIFORNIA, EARTHQUAKE OF APRIL 26, 1981

[The following report has been abstracted from Maley, R. P., and Etheredge, E. C., 1982, Strong-motion data from the Westmorland, California, earthquake of April 26, 1981: U.S. Geological Survey Open-File Report 81-1149, 18 p.]

A magnitude 5.6 earthquake occurred 8 km northwest of Westmorland, California, on April 26, 1981, triggering U.S. Geological Survey (USGS) strong-motion accelerographs at 24 of the 30 stations located in the Imperial Valley region. The earthquake triggered all instruments less than 28 km from the epicenter with the nearest record from Salton Sea, 9 km north of the epicenter (fig. 1). In addition to the network operated by the USGS, the State of California Division of Mines and Geology (CDMG) obtained records from stations located at Westmorland, Niland, and in El Centro adjacent to the former site of the Imperial County Services Building (McJunkin and Kaliakin, 1981). Data were recorded by both the USGS and CDMG networks from ground-level accelerographs (ground stations, not necessarily free-field stations) located in one-story buildings or in small fiberglass instrument shelters. Most recorders were equipped with WWVB radio receivers, but due to either poor signal or receiver-timer problems, real time was impressed on only half of the records.

Table 1 provides a summary of the accelerograph data for the 24 USGS stations. Maximum accelerations exceeded 0.10 g at four stations (fig. 2); Salton Sea 0.22 g (9 km), Brawley 0.18 g (17 km), Parachute Test 0.23 g (20 km), and Superstition Mountain 0.11 g (24 km). The first three stations are located on alluvium while the Superstition Mountain station is on granite. Although maximum accelerations are essentially equivalent at Salton Sea, Brawley, and Parachute Test, the level of motion is significantly higher and the duration longer at Salton Sea, with pulses exceeding 0.10 g for more than 6 seconds (fig. 2). The maximum accelerations in El Centro and along the El Centro array were generally 0.02 to 0.06 g. This earthquake was the second time the entire El Centro array was triggered by a single event, the first being the October 15, 1979, Imperial Valley earthquake (Porcella and Matthiesen, 1979).

McJunkin and Kaliakin (1981) reported the following accelerations for the CDMG instrumentation located in Imperial Valley: Westmorland, 7 km, 0.49 g horizontal and 0.80 g (spike) vertical; Niland, 19 km, 0.19 g horizontal and 0.13 g vertical; and El Centro, 35 km, less than 0.05 g. All CDMG instruments are located on alluvium.

S-wave minus trigger times (S-t), such as those shown in table 1, have been reported for numerous earthquakes over the past several years. The instruments are usually triggered during one of the first P-wave arrivals, but this is not always true, particularly when P-waves are small and lack a strong impulsive character. For example, during the Westmorland earthquake, El Centro 6 had an S-t interval of from 0.8 to 1.1 seconds larger (triggered earlier) than El Centro 1, 2, and 3 at nearly equivalent distances. In other instances, no S-t exists when instruments were triggered during later arrivals. For instance, trigger times obtained from the WWVB code at El Centro 7 and 8 are, respectively, 4 and 3 seconds later than station 6 although they are at essentially equal distances. The instrument at station 6 is housed in a small fiberglass shelter located 1.2 km east of the Imperial fault while station 7 is a large corrugated

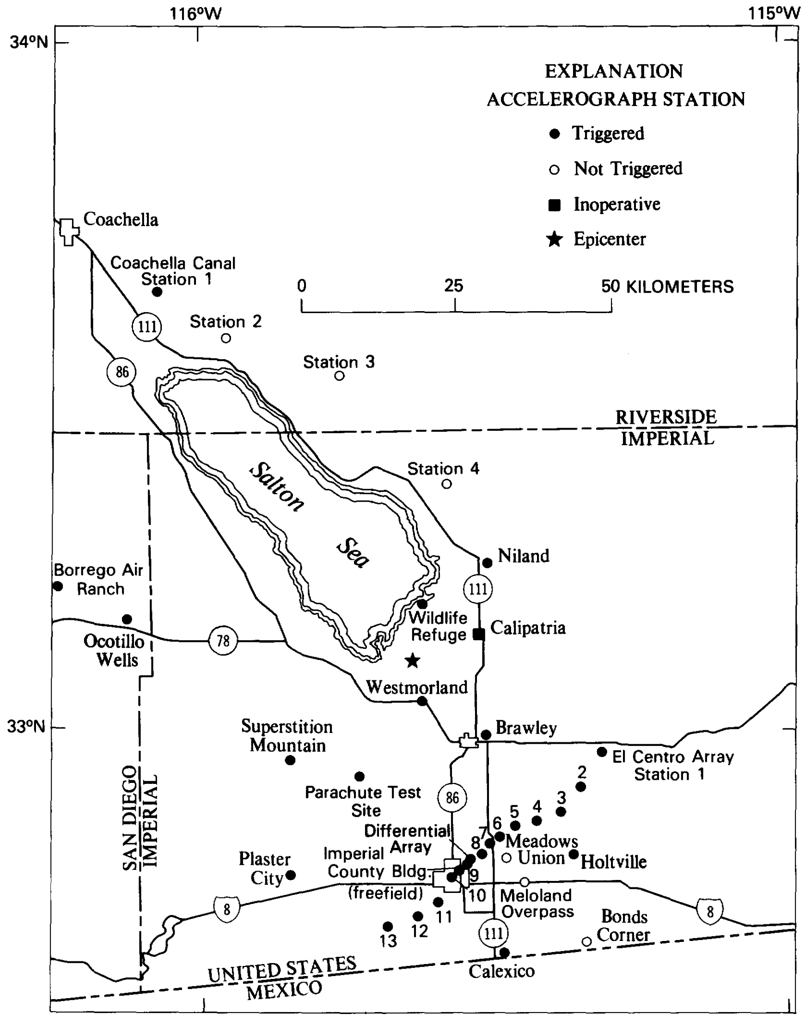

Figure 1.- Strong-motion stations in the Imperial Valley region during the Westmorland earthquake of April 26, 1981.

steel-frame building with concrete slab floor 0.7 km west of the fault. The April 26 records from station 6 show lower frequency (≈8 Hz), higher amplitude vertical motion while station 7 has higher frequency (≈20 Hz), lower amplitude vertical motion. These same characteristics were noted on aftershock recordings of the October 15, 1979, earthquake. Late triggerings could be attributed to a number of variables: site response and the effects of transmission path and source mechanism, structural modification of base shaking, and response characteristic of vertical starters, which have a peak sensitivity at 4 Hz falling off rapidly above 10 Hz. Thus, depending upon the frequency and the level of ground motion, at least for smaller events, strong-motion instruments may or may not trigger within a few tenths of a second of first P-wave arrivals. The relatively long triggering delays observed at stations 7 and 8 (3+ and 4+ seconds) would exceed the standard 2.5-second pre-event memory (PEM) used by the USGS in digital strong-motion systems. Similar delays were observed at station 9, where three accelerographs are installed: a Kinemetrics* SMA-1, a Kinemetrics* DSA-1 digital recorder with PEM, and a standard U.S. Coast and Geodetic Survey (C and GS) strong-motion accelerograph, each triggered independently by Kinemetrics* VS-1 vertical starters. An analog playback of the DSA-1 vertical component reveals there was ground motion occurring at the site at the beginning of the 2.5 seconds of recorded pre-event data. Acceleration levels were below the nominal 0.01-g triggering level for the first 1.6 seconds while the following 0.9 second shows acceleration pulses that reach and just slightly exceed 0.01 g. Two percent of g is not attained until 3.2 seconds into the recording. Although the instruments are not interconnected, relative triggering times can be determined by comparing the same phase arrivals on identical components. This comparison indicates the SMA-1 and the C and GS accelerograph triggered

* Use of product names or trademarks is for descriptive purposes only and does not imply endorsement by the U.S. Geological Survey.

approximately 2.8 to 3.0 seconds after the PEM data was being recorded. The trigger delay after ground accelerations nominally reached 0.01 g was a little more than 1 second in each instance. If smaller earthquake recordings are of sufficient seismological and/or engineering interest an additional 2.5-second PEM could be incorporated in the existing digital systems.

Numerous foreshocks and aftershocks of magnitude 3 to 4 events (Caltech Seismological Laboratory) were recorded at Salton Sea on April 26 and 27 (also reported by McJunkin and Kaliakin 1981, for CDMG's Westmorland station). Maximum

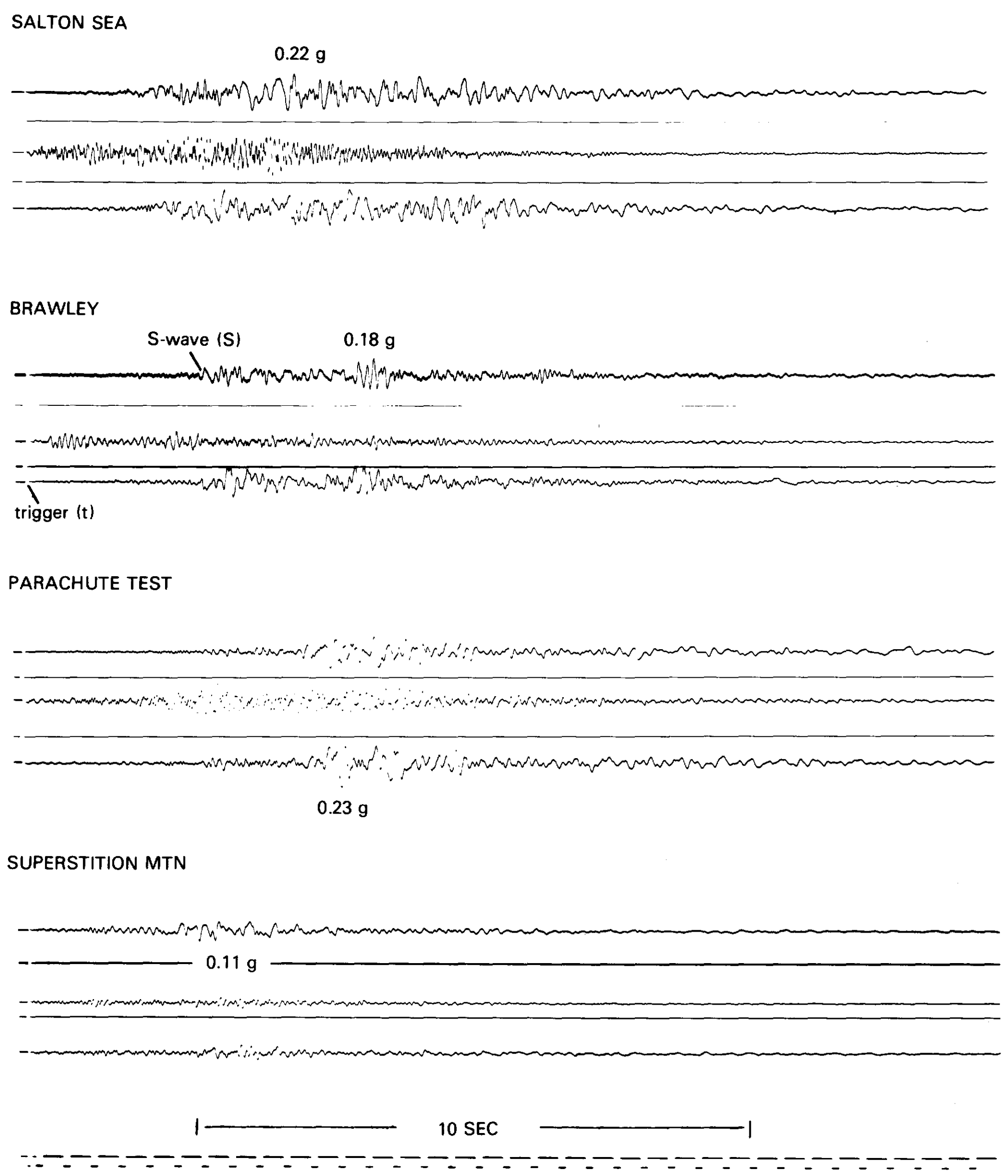

Figure 2.- USGS accelerograms greater than 0.10 g from the Westmorland earthquake of April 26, 1981 (from Maley and Etheredge, 1981).

accelerations equalled or exceeded 0.05 g during four of those earthquakes; the largest 0.11 g, was recorded 5 1/2 hours after the main shock. Fourteen of the aftershocks and one foreshock occurred during the instruments normal run time thus allowing the determination of S-wave minus P-wave times (S-P) and comparison with S-t times. The foreshock S-P was 2.3 seconds compared to S-t's of 1.9 to 2.2 seconds. The aftershock S-P's within the first 30 minutes of the main shock ranged from 2.2 to 2.8 seconds compared to S-t's of 2.3 to 2.5 seconds. This suggests the trigger delay was a few tenths of a second at Salton Sea, perhaps no larger than 0.4 second. Five hours after the main earthquake, S-P's suddenly decreased to 1.3 to 1.5 seconds for all nine measurable shocks while S-t's ranged from 1.1 to 1.3 seconds, again indicating a few tenths of second trigger delay. The later aftershocks, at least those recorded by strong-motion instruments, had migrated nearer to the recording station compared to the main event and the closely following aftershocks. Relatively local seismicity has been observed during previous earthquake sequences. For instance, seven shocks recorded at Salton Sea within two weeks after the magnitude 6.4 October 15, 1979, earthquake had small S-t times of 0.9 to 1.6 seconds, and in one instance an S-P of 1.2 seconds, (Porcella and Matthiesen, 1980), indicating a relatively near-source area. The epicenter of the 1979 earthquake was 66 km from the Salton Sea station.

References:

McJunkin, R. D., and Kaliakin, N. A., 1981, Strong-motion records recovered from the Westmorland, California earthquake of 26 April 1981: California Division of Mines and Geology Report 81-5.1, 11 p.

Porcella, R. L., and Matthiesen, R. B., 1979, Preliminary summary of the U.S. Geological Survey strong-motion records from the October 15, 1979 Imperial Valley earthquake: U.S. Geological Survey Open File Report 79-1654, 41 p.

Porcella, R. L., and Matthiesen, R. B., 1980, Strong-motion data summary, Imperial Valley earthquake of October 15, 1979 and aftershocks, _in_ Seismic Engineering Program Report, September - December 1979: U.S. Geological Survey Circular 818-C, p. 3-60.

REVISED STRONG-MOTION DATA, PART III

By R. L. Porcella

One of the primary objectives of the National Strong-Motion Network operated by the U.S. Geological Survey is to disseminate data from ground sites and structures that have been subjected to strong motion during earthquakes. These data are published initially as preliminary peak acceleration and strong duration values for each component on the recording (see Porcella and Matthiesen, 1979, for example) and later, after digitization and processing, as uncorrected acceleration; corrected acceleration, velocity, and displacement; and response spectra (see Brady and others, 1980, for example). Although the peak-acceleration value is not directly related to frequency content or duration of strong shaking, the value is readily obtained from an accelerogram and thus is widely used as a general indicator of the severity of strong shaking in studies of the attenuation characteristics of horizontal ground motion for varying earthquake magnitudes, source mechanisms, source-site distances, and recording-site conditions (Porcella, 1983).

A recent increase in real time strong-motion data at both far- and near-source distances has resulted in numerous requests from the seismological community for more detailed lists of both the recorded peak-acceleration values and source-site distances in order to utilize better these data in studies of ground motion attenuation. Tables 2 and 3 are revised lists of both U.S. Geological Survey and California Division of Mines and Geology data from the Livermore, California, earthquakes of January 24 and 26, 1980; the peak-horizontal ground acceleration recorded at each site has been rescaled to 0.001 g and is listed together with the corresponding source-site distance.

References:

Brady, A. G., Perez, V., and Mork, P. N., 1980, The Imperial Valley earthquake, digitization and processing of accelerograph records: U.S. Geological Survey Open-File Report 80-703, 309 p.

Porcella, R. L., 1983, Revised strong-motion data, _in_ Seismic Engineering Program Report, May-August 1980: U.S. Geological Survey Circular 854-B, p. 4-8.

Porcella, R. L., and Matthiesen, R. B., 1979, Preliminary summary of the U.S. Geological Survey strong-motion records from the October 15, 1979 Imperial Valley Earthquake: U.S. Geological Survey Open-File Report 79-1654, 41 p.

Table 2.- Revised CDMG and USGS ground-motion data from the Livermore earthquake of January 24, 1980

Strong-motion Station Name, Owner, and USGS Number	Coordinates	Distance (km)	Peak Horizontal Ground Acceleration (g)
Delta Pump Plant, CDWR, 1030	37.80 N 121.62 W	11.5	0.120
San Ramon, CDMG, 1418	37.729N 121.928W	16.2	.154
San Ramon, CDMG, 1383	37.78 N 121.98 W	17.2	.052
Livermore Hospital, VA, 1226	37.625N 121.762W	19.7	.175
Del Valle (toe), CDWR, 1265	37.617N 121.746W	20.7	.261
Antioch School, CDMG, 1308	38.015N 121.813W	21.2	.045
Walnut Creek, CDMG, 1530	37.906N 122.064W	25.2	.032
Pleasant Hill, CDMG, 1510	37.946N 122.060W	26.9	.033
Tracy Water Plant, CDMG, 1298	37.77 N 121.42 W	28.8	.086
Hayward, CDMG, 1524	37.655N 122.056W	29.9	.048
Oakland, CDMG, 1457	37.742N 122.148W	32.6	.016
Fremont, CDMG, 1299	37.530N 121.919W	33.3	.056
Caldecott Tunnel, CDMG, 1525	37.857N 122.214W	37.5	.020
Briones Dam Abut., CDMG, 1416	37.91 N 122.21 W	37.7	.016
APEEL Array 3E, CDMG, 1219	37.66 N 122.06 W	40.5	.065
El Cerrito, CDMG, 1419	37.897N 122.298W	44.9	.005
Halls Valley, CDMG, 1422	37.338N 121.744W	50.6	.093
San Jose, CDMG, 1507	37.338N 121.888W	52.3	.023
San Jose, CDMG, 1506	37.338N 121.893W	52.4	.011
Redwood City, CDMG, 1468	37.45 N 122.27 W	59.1	.011
South San Francisco, CDMG, 1466	37.660N 122.439W	59.4	.017
Saratoga, CDMG, 1460	37.27 N 122.01 W	62.8	.018
Capitola, CDMG, 1376	36.974N 121.952W	93.3	.023

Table 3.- Revised CDMG and USGS ground-motion data from the Livermore aftershock of January 26, 1980

Strong-motion Station Name, Owner, and USGS Number	Coordinates	Distance (km)	Peak Horizontal Ground Acceleration (g)
Fagundes Ranch, CDMG, (Temp.)	37.753N 121.772W	9.9	0.259
Morgan Park, CDMG, (Temp.)	37.819N 121.795W	13.5	.267
Delta Pump Plant, CDWR, 1030	37.80 N 121.62 W	14.3	.071
Livermore Hospital, VA, 1226	37.625N 121.762W	16.2	.059
Del Valle (toe), CDWR, 1265	37.617N 121.746W	16.8	.047
San Ramon, CDMG, 1418	37.729N 121.928W	19.9	.275
San Ramon, CDMG, 1383	37.78 N 121.98 W	24.2	.058
Antioch, CDMG, (Temp.)	37.970N 121.829W	28.0	.026
Fremont, CDMG, 1299	37.530N 121.919W	30.4	.039
Hayward, CDMG, 1524	37.655N 122.056W	31.9	.059
Antioch School, CDMG, 1308	38.015N 121.813W	32.2	.112
Walnut Creek, CDMG, 1530	37.906N 122.064W	35.9	.057
Pleasant Hill, CDMG, 1510	37.946N 122.060W	38.1	.035
Oakland, CDMG, 1457	37.742N 122.148W	38.3	.026
APEEL Array 3E, CDMG, 1219	37.66 N 122.06 W	38.9	.065
Briones Dam Abut., CDMG, 1416	37.91 N 122.21 W	47.6	.044
San Jose, CDMG, 1507	37.338N 121.888W	47.7	.006
San Jose, CDMG, 1506	37.338N 121.893W	47.8	.005
Oakland, CDMG, 1456	37.81 N 122.27 W	49.1	.026
El Cerrito, CDMG, 1419	37.897N 122.298W	54.0	.010
Saratoga, CDMG, 1460	37.27 N 122.01 W	58.6	.012
Redwood City, CDMG, 1468	37.45 N 122.27 W	58.7	.003
South San Francisco, CDMG, 1466	37.660N 122.439W	64.0	.012

SUMMARIES OF RECENT STRONG-MOTION REPORTS *

SOIL-FOUNDATION INTERACTION AND DIFFERENTIAL GROUND MOTIONS

By G. N. Bycroft

Differential ground motions due to horizontally propagating surface waves are of importance in determining the stresses and displacements developed in extended structures such as large mat foundations for nuclear power stations, dams, bridges and pipelines. A general method is developed for determining the motion of a large rigid mat foundation subjected to travelling surface waves and observations made on the relative displacements of individual foundations and their importance in bridge failure.

Reference: Journal of Earthquake Engineering and Structural Dynamics, v. 8 p. 397-404.

IN-SITU MEASUREMENTS OF SEISMIC VELOCITIES AT 19 LOCATIONS IN THE LOS ANGELES, CALIFORNIA, REGION

By T. E. Fumal, J. F. Gibbs, and E. F. Roth

Studies conducted in the San Francisco Bay region have shown that average shear-wave velocity can be related to quantitative estimates of ground motion such as amplification from nuclear explosions and earthquake intensity. Furthermore, when certain physical properties of the geologic materials such as texture, hardness, and fracture spacing are described during geologic mapping, a method can be used to predict shear-wave velocity from descriptions of geologic units. By measuring shear-wave velocities in representative geologic units, regional maps depicting the earthquake hazard can be compiled.

These studies are presently being extended to the Los Angeles Basin and the Oxnard-Ventura areas. To date, shear and compressional waves have been measured in boreholes at 46 locations. A previous report summarized seismic and geologic data at sites 1-27. This report presents the data for sites 28-46. At each location seismic travel times are measured in drill holes, normally at 2.5 m intervals to a depth of 30 m. Geologic logs are compiled from drill cuttings, undisturbed samples, and penetrometer samples. The data provide a detailed comparison of geologic and seismic characteristics and parameters for estimating strong earthquake ground motions quantitatively at each of the sites.

Reference: U.S. Geological Survey Open-File Report, 81-399, 121 p. (see section "Data Sources").

* Inclusion of strong-motion information sources is intended as a service to our readers and does not imply endorsement of these reports by the U.S. Geological Survey.

U.S. STRONG-MOTION EARTHQUAKE INSTRUMENTATION

Edited by W. D. Iwan

The U.S. National Workshop on Strong-Motion Earthquake Instrumentation was held April 12-14, 1981, on the campus of Westmont College in Santa Barbara, California. The workshop was organized by a steering committee appointed by the Earthquake Engineering Research Institute and the Universities Council for Earthquake Engineering Research.

The objectives of the workshop were to (1) review existing strong-motion instrumentation programs in the U.S., (2) develop a unified strategy for the deployment of strong-motion instruments both in the free-field and in buildings, and (3) formulate a plan for the coordination of existing strong-motion programs, the on-going installation and operation of instruments, and the management of strong-motion data. To achieve these objectives, the workshop was organized into a number of working committees covering the major areas to be addressed. This volume is the product of the combined efforts of those in attendance.

Reference: Earthquake Engineering Research Institute (see section "Data Sources") and Universities Council for Earthquake Engineering Research, 55 p. and append.

STRONG-MOTION DATA FROM THE WESTMORLAND, CALIFORNIA, EARTHQUAKE OF APRIL 26,1981

By R. P. Maley and E. C. Etheredge

A moderate earthquake occurred 8 km northwest of Westmorland, California, at 1209 (UTC) on April 26, 1981, triggering U.S. Geological Survey (USGS) strong-motion accelerographs at 24 of 30 stations located in the Imperial Valley region. The earthquake triggered all instruments less than 28 km from the epicenter with the nearest record from Salton Sea, 9 km north of the epicenter. In addition to the network operated by the Survey, the State of California Division of Mines and Geology (CDMG) obtained records from stations located at Westmorland, Niland, and in El Centro adjacent to the former site of the Imperial County Services Building. Data were recorded by both the USGS and CDMG networks from ground-level accelerographs (ground stations, not necessarily free-field stations) located in one-story buildings or in small fiberglass instrument shelters. Most recorders were equipped with WWVB radio receivers, but due to either poor signal or receiver-timer problems, real time was impressed on only half of the records.

Reference: U.S. Geological Survey Open-File Report 81-1149, 18 p. (see section "Data Sources").

AVAILABILITY OF STRONG-MOTION INFORMATION AND DATA

U.S. GEOLOGICAL SURVEY STRONG-MOTION NETWORK DATA

By April Converse

Descriptions of strong-motion accelerograph records and the circumstances in which they were recorded are available to anyone involved in earthquake engineering through the computer-based Strong-Motion Information Retrieval System (SMIRS). SMIRS provides ready access to information about strong-motion records and the level of processing and analysis that has been performed on them. Information about earthquakes that generated recorded motion and about the sites at which the motion was recorded is also provided.

With an ordinary phone line and a keyboard terminal, a SMIRS user may review the information free of charge. Once accessed, SMIRS will offer a general introduction and will tell the user how to request more detailed instructions. The user also will be given an opportunity to request a copy of the printed user's manual.

SMIRS resides in one of the U.S. Geological Survey computers in Denver, Colorado. It can be accessed by telephoning the computer center directly or by telephoning a local node in the TYMNET telecommunications network. The direct-dial telephone numbers for the Denver computer center are:

(303) 232-0058 for 300 baud modems such as those included in the TI Silent 700 terminals,
(303) 232-5309 for 1200 baud modems such as the VADIC modems,
(303) 232-2248 for 1200 baud BELL 212a modems.

The TYMNET telecommunications network can be used to access SMIRS without incurring a long-distance telephone charge to Denver. TYMNET Corporation maintains local telephone numbers in many cities in the United States and in several foreign countries. TYMNET phone numbers can be obtained from TYMNET Corporation's Western Customer Service at (800) 323-7389 or TYMNET Customer Support Group at (800) 366-0149.

Take the following steps to connect your terminal to SMIRS.

1) Set the switches, keys, or buttons on the terminal that allow a choice of operating modes:
   - transmission speed = 300 baud (30 characters per second) or 1200 baud;
   - on line;
   - lower case ASCII characters; and
   - full duplex (if you are going to dial a TYMNET number) or
   - half duplex (if you are going to dial Denver directly).
2) Plug in and turn on the terminal; turn on the modem too if it is a separate device. Notice whether the modem uses an acoustic coupler or whether the modem is directly connected to a telephone. An acoustic coupler will have a cradle into which a telephone handset can be inserted. Look for a label or diagram on an acoustic coupler that will show you in which direction the telephone cord should go. A direct-connect modem will have a switch that can be set for voice or data transmission.
3) Telephone the USGS computer center in Denver or telephone the TYMNET number nearest you; wait for a high-pitched tone.
4) Place the telephone handset in the cradle on the acoustic coupler or set the direct-connect switch to "data." Wait for the "carrier detect" light to turn on; this indicates that the terminal is receiving a signal from the computer or from the TYMNET equipment.
5) If you telephoned the Denver computer center directly, skip this section, but if you telephoned a TYMNET number, the TYMNET prompts (shown underlined here) and your responses (shown in italics here) should proceed as follows:

   please type your terminal identifier *e*
   please log in: *gsbc1234:2361:sandstone <CR>*

   The <CR> symbol represents the carriage-return key.

   The "gsbc1234" is what TYMNET refers to as a user name, the "2361" is a location identifier for the USGS computer center, and the "sandstone" is a password. Note that the "sandstone" will not be printed at your terminal while you type.

   Do not be alarmed if the first prompt comes at an odd speed.

   TYMNET will now connect your terminal to a computer selecting device in Denver. If the computer selector is operating, "GSDN is online" will be printed at your terminal.
6) Type the carriage return key. The computer selecting device will ask you to "enter class", to which you should answer "mult":

   enter class *mult <CR>*

   The selecting device will answer with several lines, something like "CONNECTING TO DENVER MULTICS" and "class mult start".
7) Type the line-feed key. The MULTICS computer will respond with several lines that will tell you which computer you have accessed, how many other users are connected, and so forth.

8a) If your terminal will transmit both upper and lowercase characters, type:

   enter <your_name> SMIRS <CR>

   The <CR> represents the carriage-return key and <your_name> is your own name typed without any embedded blanks. It is good practice for you to choose a version of your name that will probably be unique, and to use that version of your name every time you log onto SMIRS. That way, any messages sent to you through SMIRS will not be received by the wrong user.

Note that the word "enter" is in lower case and "SMIRS" is in upper case.

8b) If your terminal has only uppercase characters, type:

```
MAP <CR>
ENTER <YOUR_NAME> \S\M\I\R\S  <CR>
```

The "MAP" statement instructs the computer to interpret all the alphabetic characters you will subsequently type as though they were in lowercase, except those characters that follow a left slant (\).

9) From now on, SMIRS will prompt you whenever it expects you to type something. All the prompt lines begin and end with two dashes; answer by typing a question mark if you do not know what is expected of you.

Do not be concerned if the computer does not respond immediately after you enter SMIRS. The response time may improve in the future, but it will always be fastest during nonworking hours (Denver time).

CALIFORNIA DIVISION OF MINES AND GEOLOGY STRONG-MOTION DATA

Processed strong-motion data from selected earthquakes are available from the California Division of Mines and Geology (CDMG). The data have been prepared by the interim CDMG strong-motion data processing system. This system is composed of a series of programs that have been developed by the California Institute of Technology, the USGS, and the CDMG, with special emphasis on the handling of long-duration film records from multiple-channel central recording instruments.

The data are grouped by phase:

- Phase I — Uncorrected accelerations,
- Phase II — Corrected accelerations, velocities, and displacements,
- Phase III — Response spectra.

Each phase contains three-channel subgroups arranged by station. At the present time, data from the following earthquakes have been processed:

Santa Barbara earthquake of August 13, 1978

Station	Channels
UCSB Goleta	3
UCSB North Hall	9
Freitas Building	9

Imperial Valley earthquake of October 15, 1979

Station	Channels
El Centro free-field	3
Imperial County Services Bldg.	13

The data are available on standard nine-track tapes, along with a microfiche copy of the tape contents. Interested parties should contact the CDMG Office of Strong-Motion Studies (see section "Data Sources").

It is the policy of the CDMG to make all strong-motion record data promptly available to the public in a manner consistent with good data management. Requests for copies of records, personal access to record or data files, and copies of data files should be made to the Chief, Office of Strong-Motion Studies (OSMS), and should specify identity and medium of materials to be provided or reviewed. Desired access or delivery dates should be specific. When a request for copies of materials or personal access to files is received, OSMS staff will provide the requested material or will set an appointment time for personal review of files; the requestor will be notified immediately of any significant delay or other problems that prevent meeting the request. Charges for copying or other processing of materials will be based on the actual cost of producing and delivering the items, and OSMS will retain control of originals and master copies of all items.

FOREIGN STRONG-MOTION DATA

Because of the long history of close cooperation between the United States and the Central and South American strong-motion programs, much of the data from those programs are available from the same sources as the United States data (see below). Information about strong-motion data from the Western Hemisphere will be included in the Strong-Motion Information Retrieval System operated by the USGS.

The USGS does not attempt to obtain first-class copies of records from those foreign organizations that prepare data reports comparable to those prepared by the USGS. Abstracts of the data reports from such organizations are presented in this Seismic Engineering Program Report series, and through informal arrangements, copies of the data and records are made available.

NOAA WORLDWIDE STRONG-MOTION DATA

A worldwide collection of strong-motion seismograms for dissemination to the scientific and engineering community is available from World Data Center A for Solid Earth Geophysics, National Geophysical Data Center (NGDC). Countries contributing to the strong-motion data base include Australia, Italy, Japan, New Zealand, Rumania, U.S.S.R., and Yugoslavia. The USGS has furnished records from its network of cooperative strong-motion stations, including those in Central and South America.

Copies of strong-motion records are available on 35-mm film, on 70-mm film chips, as paper copies, and as digitized data on punched cards or magnetic tape. A list of most records can be obtained from the World Data Center A publication "Catalog of Seismograms and Strong-motion Records," Report SE-6. This catalog can be ordered from NGDC (NOAA) for $3.00

(see section "Data Sources").

The most significant strong-motion records recorded in the United States and Latin America between 1931 and 1971 have been copied on seven reels of 35-mm film (x12 reduction) and 70-mm film chips (approximately x8 reduction). The film chips are available for $1.50 per chip; longer records are continued on additional chips. The 35-mm film copies can be purchased for $30 per reel, the complete set of reels for $180. There is a minimum charge of $10 per order. Check with the National Geophysical Data Center for current prices before placing an order.

Japan and Australia have supplied magnetic tapes of digitized data from stations located in the western Pacific Ocean (the Japanese Islands, New Guinea, and New Britain). A series of 400 United States strong-motion records (1933-71) were digitized by the California Institute of Technology and are now available on six magnetic tapes. The USGS is digitizing post-1971 records from its network; they have generated 15 tapes of strong-motion records recorded from 1967 to 1981 in the United States, Chile, Nicaragua, San Salvador, and Mexico.

Other digitized data include punched cards containing strong-motion records from the March 4, 1977, earthquake in Rumania (recorded in Bucharest); the Gazli earthquake of May 17, 1976, in Uzbek, U.S.S.R.; and three earthquakes in the New Madrid seismic zone (located in midcontinental United States) in 1975 and 1976.

Recent acquisitions include a magnetic tape of strong-motion records triggered by a swarm of earthquakes that occurred in northern Italy near the town of Friuli in 1976; these were compiled by the National Commission for Nuclear Energy and have been given to the center for distribution. Other data include records obtained from California earthquakes near Santa Barbara in August 1978, Gilroy in August 1979, El Centro in October 1979, and Livermore in January 1980.

A table listing all digitized strong-motion records available on magnetic tape may be obtained free of charge from NOAA. Digitized strong-motion records may be purchased either in punched card format (including all three instrument components) or in tape format.

Checks or money orders should be made payable to "Commerce/NOAA/NGDC"; inquiries should be addressed to NOAA (see section "Data Sources").

DATA SOURCES

For reports or information regarding strong-motion records and data, address inquiries to the appropriate agency listed below:

1. Branch of Distribution (804) 756-6141
   U.S. Geological Survey (FTS) 756-6141
   604 S. Pickett Street
   Alexandria, VA 22304

2. Earthquake Engineering (415) 848-0972
   Research Institute
   2620 Telegraph Avenue
   Berkeley, CA 94704

3. National Geophysical (303) 497-6764
   Data Center (FTS) 320-6764
   NOAA, Code E/GC11
   325 Broadway Street
   Boulder, CO 80303

4. National Technical (703) 487-4650
   Information Service (FTS) 737-4650
   5285 Port Royal Road
   U.S. Dept. of Commerce
   Springfield, VA 22161

5. NISEE/Computer Applications (415) 642-5113
   519 Davis Hall, UC Berkeley
   Berkeley, CA 94720.

6. Office of Strong-Motion (916) 322-3105
   Studies (FTS) 552-3105
   California Division of
   Mines and Geology
   2811 "O" Street
   Sacramento, CA 95816

7. Open-File Services Section (303) 234-5888
   Branch of Distribution (FTS) 234-5888
   U.S. Geological Survey
   Box 25425, Federal Center
   Denver, CO 80225

8. National Strong-Motion
   Program (415) 323-8111
   U.S. Geological Survey ext 2881
   345 Middlefield Road, MS 77 (FTS) 467-2881
   Menlo Park, CA 94025.

Table 1 . - *Summary of U.S. accelerograph records recovered during 1981*

Event	Station name (owner)[1]	Station coord.	S-t[2] (s)	Direction[3]	Max accl[4] (g)	Duration[5] (s)
14 February 1981 0609 UTC Washington 46.35N, 122.24W Magnitude 5.5	Mud Mountain Dam Crest (ACOE)	47.14° N 121.93° W	*		**	
28 September 1980- 5 March 1981 Hawaii Epicenters and magnitudes unknown	Honokaa, Hawaii Fire Station (USGS)	20.080° N 155.465° W	*		**	
	Note: Four additional records** recovered.					
	Hawaii Nat'l Park, HI Wahaula Util. Center (USGS)	19.329° N 155.031° W	*		**	
	Note: Two additional records** recovered.					
	Mauna Loa, Hawaii NOAA Observatory (USGS)	19.539° N 155.580° W	4.7	030° Up 300°	0.06 .05 .09	- - -
	Note: Two additional records** recovered.					
	Pahala, Hawaii Kau Hospital (USGS)	19.20° N 155.47° W	*	188° Up 098°	.03 .04 .07	- - -
	Note: One additional record** recovered.					
	Waiohinu, Hawaii Kau Baseyard (USGS)	19.070° N 155.615° W	*		**	
5 March 1981 1409 UTC Hawaii 21.02N, 156.99W Magnitude 5.5	Molokai Airport Fire Station (USGS)	21.158° N 157.096° W	2.9	150° Up 060°	.19 .07 .13	0.3 - 2-peaks
10 March 1981 2356 UTC Cent. California 36.86N, 121.67W Magnitude 3.4	Watsonville Array #1 Anzar Road (USGS)	36.885° N 121.589° W	*		**	

See footnotes at end of table.

Table 1 . - *Summary of U.S. accelerograph records recovered during 1981* - continued

Event	Station name (owner)[1]	Station coord.	S-t[2] (s)	Direction[3]	Max accl[4] (g)	Duration[5] (s)
2 April 1981 1610 UTC Colorado 39.91N, 104.96W Magnitude 3.8	Denver Regency Inn Basement (USGS)	37.771° N 104.992° W	2.1		**	
26 April 1981 1209 UTC So. California 33.13N, 115.65W Magnitude 5.6	El Centro Station 1 Borchard Ranch (USGS)	32.960° N 115.319° W	2.0	230° Up 140°	0.05 .02 .06	- - -
	El Centro Station 2 Keystone Road (USGS)†	32.916° N 115.366° W	2.4		**	
	El Centro Station 3 Pine Union School (USGS)†	32.894° N 115.380° W	2.5		**	
	El Centro Station 4 Anderson Road (USGS)†	32.864° N 115.432° W	*		**	
	El Centro Station 5 James Road (USGS)	32.855° N 115.466° W	0.3	230° Up 140	.05 .02 .05	- - -
	El Centro Station 6 Huston Road (USGS)	32.839° N 115.487° W	3.2	230° Up 140°	.05 .03 .05	- - -
	El Centro Station 7 Imperial Valley Coll. (USGS)	32.829° N 115.504° W	*	230° Up 140°	.04 .02 .04	- - -
	El Centro Station 8 Cruickshank Road (USGS)†	32.811° N 115.532° W	1.3	230° Up 140°	.05 .06 .06	- - -
	El Centro Station 9 Commercial Avenue (USGS)† (film record)	32.794° N 115.549° W	2.8		**	
	El Centro Station 9 Commercial Avenue (USGS)† (paper record)	32.794 N 115.549 W	*		**	

See footnotes at end of table.

Table 1 . - *Summary of U.S. accelerograph records recovered during 1981* - continued

Event	Station name (owner)[1]	Station coord.	S-t[2] (s)	Direction[3]	Max accl[4] (g)	Duration[5] (s)
26 April 1981 1209 UTC -continued-	El Centro Station 10 Community Hospital (USGS)†	32.780° N 115.567° W	2.4		**	
	El Centro Station 11 McCabe School (USGS)†	32.752° N 115.594° W	1.8		**	
	El Centro Station 12 Brockman Road (USGS)†	32.718° N 115.637° W	4.2		**	
	El Centro Station 13 Strobel Residence (USGS)	32.709° N 115.683° W	2.9		**	
	El Centro Diff. Array Dogwood Road (USGS) (film record)	32.796° N 115.535° W	1.5	360° Up 270°	0.06 .02 .08	- - -
	Calexico Fire Station Fifth Street (USGS)	32.669° N 115.492° W	5.5		**	
	Holtville Post Office (USGS)	32.812° N 115.377° W	3.1		**	
	Plaster City Storehouse (USGS)†	32.79° N 115.86° W	*		**	
	Salton Sea Wildlife Refuge (USGS)	33.18° N 115.62° W	2.3	315° Up 225°	.19 .22 .20	5.5 4.5 6.2
	Note: Five pre-event** and five post-event records** recovered at Salton Sea Wildlife Refuge.					
	Brawley Municipal Airport (USGS)	32.988° N 115.509° W	3.0	315° Up 225°	.17 .10 .16	0.6 1-peak 2.8
	Superstition Mtn. USN Camera Site (USGS)	32.955° N 115.823° W	2.1	135° Up 045°	.11 .05 .08	2-peaks - -

See footnotes at end of table.

Table 1 . - *Summary of U.S. accelerograph records recovered during 1981* - continued

Event	Station name (owner)[1]	Station coord.	S-t[2] (s)	Direction[3]	Max accl[4] (g)	Duration[5] (s)
26 April 1981 1209 UTC -continued-	Parachute Test Site Imler Road (USGS)	32.93° N 115.70° W	3.1	315° Up 225°	0.16 .13 .23	1.6 3.9 2.4
	Coachella Canal Station 1 (USGS)	33.64° N 116.08° W	7.5		**	
	Ocotillo Wells Burro Bend Cafe (USGS)	33.14° N 116.13° W	*		**	
	Borrego Air Ranch Borrego Springs (USGS)	33.19° N 116.28° W	*		**	
5 May 1981 2128 UTC Southern Alaska 61.66N, 149.66W Magnitude 4.4	Anchorage Westward Hotel (USGS)	61.220° N 149.892° W	*		**	
8 June 1981 0309 UTC Central California 36.75N, 121.36W Magnitude 4.2	Bear Valley Sta. 5 Callens Ranch (USGS)	37.673° N 121.195° W	*		**	
	Bear Valley Sta. 12 Williams Ranch (USGS)	36.658° N 121.249° W	3.5		**	
	Hollister City Hall Annex (USGS)	36.85° N 121.40° W	2.9		**	
28 January 1980- 25 June 1981 Central California Epicenter and magnitude unknown	Hayward City Hall (CHY)	37.68° N 122.08° W	*			
	Sixth floor				**	
	Eleventh floor				**	
14 October 1980- 25 June 1981 Central California Epicenters and magnitudes unknown	Bear Valley Sta. 10 Webb Residence (USGS)	36.532° N 121.143° W	1.6		**	
	Note: Five additional records** recovered.					

See footnotes at end of table.

Table 1 . - *Summary of U.S. accelerograph records recovered during 1981* - continued

Event	Station name (owner)[1]	Station coord.	S-t[2] (s)	Direction[3]	Max accl[4] (g)	Duration[5] (s)
26 June 1981 0143 UTC Central California 36.56N, 121.24W Magnitude 3.0	Bear Valley Sta. 10 Webb Residence (USGS)	36.532° N 121.143° W	1.6	310° Up 220°	0.07 .03 .05	- - -
2 July 1981 0923 UTC Central California Epicenter and magnitude unknown	Bear Valley Sta. 10 Webb Residence (USGS)	36.532° N 121.143° W	1.4		**	
25 July 1981 2148 UTC Central California 36.55°N, 121.07°W Magnitude 3.0	Bear Valley Sta. 14 Upper Butts Ranch (USGS)	36.569° N 121.043° W	*		**	
	Bear Valley Sta. 11 Wilkinson Ranch (USGS)	36.608° N 121.109° W	*		**	
11 February 1981- 28 July 1981 So. California Epicenters and magnitude unknown	Diemer Filter Plant (MWD)	33.91° N 117.82° W	0.3			
	Basement				**	
	Reservoir roof				**	
	Note: Two additional records** recovered at reservoir roof.					
14 August 1981 1249 UTC Central California 36.77N, 121.29W Magnitude 4.2	Bear Valley Sta. 12 Williams Ranch (USGS)	36.658° N 121.249° W	3.7		**	
2 February 1981- 1 September 1981 No. California Epicenters and magnitudes unknown	Palo Alto VA Hospital Building 1 (VA)	37.40° N 122.14° W				
	Basement				**	
	Roof				**	
	Note: Two each additional records** recovered at basement and roof.					

See footnotes at end of table.

Table 1 . - *Summary of U.S. accelerograph records recovered during 1981* - continued

Event	Station name (owner)[1]	Station coord.	S-t[2] (s)	Direction[3]	Max accl[4] (g)	Duration[5] (s)
25 March 1981- 9 September 1981 Central California Epicenter and magnitude unknown	SAGO Central Harris Ranch (USGS)	36.76° N 121.45° W	*		**	
11 September 1981 0502 UTC SE Alaska 60.07N, 139.57W Magnitude 4.1	Bancas Point (USGS)	59.953° N 139.635° W	*	360° Up 270°	0.06 .02 .05	- - -
14 September 1981 0819 UTC Central California 36.66N, 121.33W Magnitude 3.1	Bear Valley Sta. 12 Williams Ranch (USGS)	36.658° N 121.249° W	1.9		**	
6 October 1980- 16 September 1981 Southern Hawaii Epicenters and magnitudes unknown	Mauna Kea, Hawaii State Park Center (USGS) Note: Three additional records** recovered.	19.752° N 155.530° W	*		**	
3 March 1981- 17 September 1981 Southern Hawaii Epicenters and magnitudes unknown	Hawaii Nat'l Park, HI Volcano Observatory (USGS) Note: Two additonal records** recovered.	19.423° N 155.291° W	*		**	
	Hawaii Nat'l Park, HI Wahaula Util. Center (USGS) Note: One additional record** recovered.	19.329° N 155.031° W	1.2		**	
	Mauna Loa, Hawaii NOAA Observatory (USGS)	19.539° N 155.580° W	2.1		**	

See footnotes at end of table.

Table 1 . - *Summary of U.S.accelerograph records recovered during 1981* - continued

Event	Station name (owner)[1]	Station coord.	S-t[2] (s)	Direction[3]	Max accl[4] (g)	Duration[5] (s)
17 September 1981 0018 UTC SE Alaska 60.03N, 139.39W Magnitude 4.3	Bancas Point (USGS)	59.953° N 139.635° W	*	360° Up 270°	0.05 .01 .05	- - -
21 May 1981- 19 September 1981 Central Alaska Epicenters and magnitudes unknown	Anchorage New Federal Bldg. (USGS)	61.216° N 149.883° W	9.5			
	Basement				**	
	Anchorage Alaska Hospital (USGS)	61.21° N 149.82° W	*			
	Ground floor				**	
	Fourth floor				**	
	Seventh floor				**	
	Anchorage Westward Hotel (USGS)	61.220° N 149.892° W	9.4			
	Basement				**	
	Roof				**	
	Note: Two each additional records** recovered at basement and roof.					
	Talkeetna FAA-VOR Bldg. (USGS)	62.30° N 150.10° W	*		**	
15 September 1981- 27 September 1981 Central California Epicenter and magnitude unknown	Bear Valley Sta. 12 Williams Ranch (USGS)	36.658° N 121.249° W	1.9		**	

See footnotes at end of table.

Table 1 . - *Summary of U.S. accelerograph records recovered during 1981* - continued

Event	Station name (owner)[1]	Station coord.	S-t[2] (s)	Direction[3]	Max accl[4] (g)	Duration[5] (s)
28 September 1981 0734 UTC Central California 36.79N, 121.59W Magnitude 3.9	Bear Valley Sta. 12 Williams Ranch (USGS)	36.658° N 121.249° W	3.8		**	
30 September 1981 1153 UTC Eastern California 37.59N, 118.89W Magnitude 5.9	Lake Success Dam (ACOE)	36.061° N 118.920° W	0.8			
	Downstream				**	
	Left abutment				**	
	Left crest				**	
	Right abutment				**	
	Right crest				**	
	Slope				**	
1 October 1981 1922 UTC Central California Epicenter and magnitude unknown	Bear Valley Sta. 10 Webb Residence (USGS)	36.532° N 121.143° W	1.6		**	
24 August 1979- 6 October 1981 Central California Epicenter and magnitude unknown	San Francisco Transamerica Bldg. (TA)	37.795° N 122.401° W	*			
	Sub-basement				**	
	24th floor				**	
	49th floor				**	
	58th floor				**	

Note: One additional record** recovered at 58th floor.

See footnotes at end of table.

Table 1 . - *Summary of U.S. accelerograph records recovered during 1981* - continued

Event	Station name (owner)[1]	Station coord.	S-t[2] (s)	Direction[3]	Max accl[4] (g)	Duration[5] (s)
8 October 1981 2020 UTC Southern California Epicenter and magnitude unknown	Pinyon Flat Observ. (USGS)	33.61° N 116.46° W	*		**	
20 October 1981 1241 UTC Southern California 33.52N, 116.45W Magnitude 3.0	Pinyon Flat Observ. (USGS)	33.61° N 116.46° W	*		**	
22 September 1981- 27 October 1981 Central California Epicenter and magnitude unknown	Hollister City Hall Annex (USGS)	36.85° N 121.40° W	3.0		**	
10 June 1981- 10 December 1981 Central California Epicenter and magnitude unknown	Terminus Dam Crest (ACOE)	36.41° N 119.00° W	*		**	

[1] Station owner code:
- ACOE - U.S. Army Corps of Engineers.
- CHY - City of Hayward.
- MWD - Metropolitan Water District of Southern California.
- USGS - U.S. Geological Survey.
- VA - Veterans Administration.
- TA - Transamerica Building.
- † - WWVB time code not legible or instrument not equipped with a radio receiver; correlation of accelerogram with event may be questionable.

[2] S-wave arrival minus trigger time (S - t) interval.
- * S-t time is questionable or cannot be determined.

[3] Direction of case acceleration for upward trace deflection on accelerogram. Horizontal components are listed as azimuth in degrees clockwise from north. Vertical components are listed as "up" or "down."

[4] Peak acceleration recorded at ground level on one vertical and two orthogonal horizontal components unless otherwise noted.
- ** Denotes maximum acceleration is less than 0.05 g at ground level or less than 0.10 g at non-ground-level stations.

[5] Duration between first and last peaks of acceleration greater than 0.10 g.

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