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GEOLOGICAL SURVEY CIRCULAR 736–A

Seismic Engineering Program Report, January–March 1976

Prepared on behalf of the
National Science Foundation
Grant CA–114

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Any opinions, findings, conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

1976

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United States Department of the Interior

THOMAS S. KLEPPE, *Secretary*

Geological Survey

V. E. McKelvey, *Director*

Free on application to Branch of Distribution, U.S. Geological Survey, 1200 South Eads Street, Arlington, VA 22202

PREFACE

This Seismic Engineering Program Report is an informal document primarily intended to keep the ever-growing community of strong-motion data users apprised of the availability of data recovered by the Seismic Engineering Branch of the U.S. Geological Survey. The Seismic Engineering Program of strong-motion instrumentation is supported by the National Science Foundation (Grant CA-114) in cooperation with numerous Federal, State, and local agencies and organizations.

This issue contains a summary of all accelerograph records obtained during the period January-March, 1976. Preliminary reports on the southern California earthquake of January 1 and the Guatemala earthquake of February 4 are presented, along with several abstracts and information on the availability of digitized data. The information presented in table 1 was recovered, although not necessarily recorded during the past quarter. This procedure will be followed in future issues in order that the dissemination of data may be as expeditious and current as practicable.

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U.S. Geological Survey
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Menlo Park, CA 94025

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SEISMIC ENGINEERING PROGRAM REPORT, JANUARY - MARCH 1976

RECENT ACCELEROGRAPH RECORDS

by R. L. Porcella

The U.S. Geological Survey's Seismic Engineering Program of strong-motion instrumentation has recovered an average of 56 accelerograph records per quarter since 1 January 1972. Twenty-one records were obtained during the first quarter of 1976, and eleven of these are related to the southern California event of January 1. Table 1 presents a summary of the records obtained during the period January - March 1976 and includes maximum accelerations, S-wave minus trigger times, and time durations for which the acceleration level exceeded 0.10 g.

Preliminary strong-motion results from the January 1 Puente Hills, California earthquake are described below.

The central Arizona earthquake of February 3 produced only one strong-motion record at the Phoenix V.A. hospital (maximum acceleration 0.04 g). The magnitude 5.0 event was centered northwest of Phoenix (34.70°N, 112.53°W) at a depth of 5 km (W. Person, National Earthquake Information Service, oral communication, Feb., 1976).

Two seismoscope records were recovered from instruments at the university at Guatemala City after the destructive earthquake (magnitude 7 1/2) that struck that region on February 4, 1976.

The first accelerograph record from the newly established strong-motion network in Nicaragua was obtained from a ground level site at Chinandega on March 1, 1976. The accelerograph was located in a one-story concrete structure and recorded a maximum horizontal ground acceleration of approximately 0.05 g. The network currently consists of 23 accelerographs and 34 seismoscopes and is administered by the Instituto De Investigaciones Sismicas.

A magnitude 4.7-5 earthquake occurred in northeastern Arkansas (35.6°N, 90.5°W) at a depth of 5 km on March 24 (NEIS, oral communication, March 1976). Seven accelerographs located 125 to 150 km from the epicenter were triggered, but a preliminary analysis of the records shows only minor ground level accelerations (less than 0.05 g).

PRELIMINARY REPORTS ON RECENT EARTHQUAKES

STRONG-MOTION RESULTS FROM THE PUENTE HILLS, CALIFORNIA EARTHQUAKE OF 1 JANUARY 1976

by E. C. Etheredge and J. D. Nielson

A magnitude 4.2 earthquake occurred on 1 January 1976 (0920 PST) in the Puente Hills of eastern Los Angeles County at a depth of approximately 8 km (Pasadena). The epicenter was located about 4 km north of the Whittier fault zone at 33.97°N and 117.89°W (Pasadena). According to D. Hadley (oral communication), of the Pasadena Seismological Laboratory, the earthquake apparently occurred along a small fault that strikes N26°E and dips 72°NW (fig. 1). Minor damage, which primarily included broken plate glass windows and cracked plaster, was reported at La Habra, about 5 km south of the epicenter. Telephone service in some areas was temporarily disrupted. In addition to being felt in Los Angeles and Orange Counties, the earthquake was felt approximately 80 km (50 mi) eastward into San Bernadino and Riverside Counties (Whittier Daily News, January 2, 1976).

Eleven strong-motion accelerograph records were obtained from within a 14-km radius of the epicenter (fig. 1). All stations recorded peak accelerations of 0.10 g or greater, except the two instruments at Diemer Filtration Plant (see table 1). The maximum recorded acceleration (0.28 g) occurred in Whittier, about 13.8 km west of the epicenter. The accelerograph was located at the fifth floor level of the ten-story building at 7215 Bright Avenue. The peak acceleration recorded at the basement level was 0.17 g and at the tenth floor level was 0.19 g. Orange County Reservoir, 3.5 km south of the epicenter, recorded a peak acceleration of 0.18 g. Records produced during the January 1 event are shown in figure 2.

Seismograms from the two Carbon Canyon Dam abutment stations show peak accelerations of 0.14 g. The crest station recorded a slightly lower (0.12 g) peak acceleration. The main embankment of the dam is an earthfill structure 30 m (99 ft) high and 578 m (1925 ft) long, constructed across the downstream narrows of Carbon Canyon. It rests on approximately 30 m (100 ft) of Recent alluvium. Three accelerographs, installed in June, 1975, were not interconnected for simultaneous start or time. A comparison of S-wave minus trigger intervals indicates that the three instruments triggered within 0.1 second of one another, thus demonstrating the relative efficiency of the vertical starter. The combined use of vertical starters for triggering, and WWVB radio receivers for simultaneous time, should eliminate the need for interconnecting wire and conduit at such multiple-instrumentation locations as dams.

PRELIMINARY REPORT ON THE GUATEMALA EARTHQUAKES OF FEBRUARY 1976

by C. F. Knudson

A destructive earthquake of surface wave magnitude 7.5 (National Earthquake Information Service, Feb. 1976) occurred in Guatemala at 09:01:46 Greenwich Civil Time on February 4, 1976. The earthquake (and a series of aftershocks) caused great damage and loss of life in Guatemala, completely destroying many cities and villages. Horizontal displacements of 60 to 120 cm were measured along the Motagua fault for a distance of over 200 km (fig. 3) (Page, 1976).

Two strong-motion accelerographs and three seismoscopes were located in Guatemala City at the time of the February 4 earthquake. One accelerograph, model RFT-250, had not been reinstalled after repairs. The second accelerograph, a C&GS 12" Montana type, did not record the event because the lamp burned out when full lamp voltage was applied at the time of the earthquake. The only strong-motion records obtained in Guatemala were from the two seismoscopes installed at the university.

The Centro De Investigaciones De Ingenieria of Ciudad Universitaria purchased one RFT-250 accelerograph and three seismoscopes in the late 1960's. Two of the seismoscopes were installed in the administration building at the university, one on the ground floor and the other on the roof. The seismoscope that was not installed at the time of the earthquake was subsequently installed alongside the SMA-1 in the IBM building near the center of Guatemala City. A significant event recorded on both the accelerograph and the seismoscope could be useful in the correlation of the two types of strong-motion records. The two seismoscope records were recovered on February 10, 1976. The university is approximately 27 km from the surface rupture that occurred along the Motagua fault. The administration building at the university is a four-story building (approx. 30 x 60 m). The seismoscope plate from the instrument on the roof of the building had been dislodged, and the record shows that motion had exceeded the maximum radius of the plate before it became dislodged. The seismoscope plate from the ground floor level (fig. 4) remained on the instrument and reveals a maximum relative displacement of S_d = 5.3 cm. This record will be further analyzed in order to recover ground accelerations.

Maximillo Martinez, Director of the San Salvador Observatory, reported that an AR-240 accelerograph located in San Salvador at the Bibloteca station was triggered by the Guatemala earthquake. Preliminary peak accelerations obtained from this record were reportedly .07 g on the north component, .03 g on the vertical, and .05 g on the east component.

These readings were given over the telephone; a record copy is being mailed to the USGS office in Menlo Park but was not available at the time of this writing. Martinez reported further that this earthquake was felt in San Salvador, and he rated it an Intensity V.

Four SMA-1 accelerographs were sent to Guatemala for installation by the USGS after the February 4 event. In view of the preliminary location of the epicenters for the February 6, 8, 9, and 10 shocks and considering the more than 200 km of surface breakage on the Motagua fault (plus surface breakage on the Mexico fault), it was decided that the best locations for recording other strong aftershocks would be at Puerto Santo Tomas, Zacapa, Chichastenango, and near the center of Guatemala City (fig. 3). The four accelerographs have been installed as temporary aftershock instruments and will be removed in 2 or 3 months.

Several aftershocks were recorded on the accelerographs at the Zacapa station, the Observatory station, and the IBM building. Each of these aftershocks was less than 4.0 Richter magnitude. The records obtained show less than .05 g peak acceleration and are considered insignificant. An aftershock was recorded at the IBM building on February 18, 1976 at 03:59 local time. The National Observatory reported this earthquake as having an intensity of III to IV and located it in the region of El Progesso. The record (fig. 5) is interesting in that it shows a peak vertical acceleration of approximately 0.1 g during the initial one second of the record.

Reference: Page, R. A., ed., 1976, Interim report on the Guatemalan earthquake of February 1976 and the activities of the U.S. Geological Survey earthquake investigation team: U.S. Geol. Survey open-file rpt. 76-295, 31 p.

ABSTRACTS OF RECENT REPORTS

CALIFORNIA BUILDING STRONG-MOTION EARTHQUAKE INSTRUMENTATION PROGRAM

By Christopher Rojahn

On the basis of the recommendations of a special ad-hoc committee, twenty-one geographic areas will be instrumented under the building instrumentation phase of the California Strong-Motion Instrumentation Program, a statewide program established by law in 1971 and funded through an assessment of estimated construction costs collected statewide from building permits. The areas were selected on the basis of population density, locations of buildings already instrumented, and the probability for potentially damaging earthquakes. Buildings to be instrumented will be of typical construction, simple in framing and design, and of various heights with the instrumentation of low-rise buildings emphasized. Remote recording instrumentation, consisting of single or multiaxial accelerometers connected via data cable to a central recorder, will be installed in each building. The accelerometers will be placed on the lowest level, at the roof level, and, in many buildings, at one or more intermediate levels. The instrumentation will be situated so as to separately record both translational and torsional response.

As of March 1976, 54 buildings have been recommended for instrumentation under the program; 5 of these have been instrumented. On the basis of current income, it is projected that as many as 400 buildings will be instrumented under the program.

Reference: Proc. ASCE Conference on Dynamic Response of Structures: Instrumentation, Testing Methods, and System Identification, UCLA, March, 1976, p. 40-60.

FORCED-VIBRATION TESTS OF A THREE-STORY REINFORCED CONCRETE FRAME AND SHEAR-WALL BUILDING IN TADZHIK, S.S.R.

Christopher Rojahn and S. H. Negmatullaev

Two forced-vibration tests in which chemical explosives were used to generate strong ground motion were conducted on a full-scale three-story reinforced concrete frame and shear-wall building at a test site near Laur, Tadzhik, S.S.R. The building was instrumented with a 10-channel remote-recording accelerograph system with one vertical and four horizontal accelerometers located at the roof level, one horizontal accelerometer on each of the second and third floors, and a triaxial package on the foundation. In both a 2-ton single charge explosion test and a 12-ton sequential explosion test (six 2-ton explosions detonated at 0.5-second intervals) peak accelerations on the order of 0.1 g were recorded at the foundation and the upper levels. A preliminary analysis indicates that the building responded primarily in the first two translational modes and that in-plane bending of the roof may have occurred. Vertical motion at an interior column-roof intersection was amplified with respect to the vertical foundation motion.

The tests were conducted as part of an engineering seismology project emanating from the 1972 Joint U.S.-U.S.S.R. Agreement on Cooperation in the Field of Environmental Protection.

Reference: Proc. ASCE Conference on Dynamic Response of Structures: Instrumentation, Testing Methods, and System Identification, UCLA, March, 1976, p. 159.

SOIL-STRUCTURE INTERACTION AT HIGHER FREQUENCY FACTORS

By G. N. Bycroft

Approximate solutions to the forced-vibrations of a rigid circular plate attached to the surface of an elastic half-space are presented for large values of the frequency factor. These results are important when solving soil-structure interaction problems when such problems involve high-frequency factors. This situation arises when high-frequency components of earthquakes impinge on a relatively rigid foundation of large base area located on soft terrain. Similar situations occur in cases of blast loadings and impact and in the foundations of large high-speed machinery. These solutions are used to solve the problem of the motion of a rigid mass on an elastic half-space subjected to steady state and transient horizontal accelerations. From these results it is deduced that a large rigid mat foundation located on soft terrain significantly attenuates input accelerations and consequently may be useful as the foundation of a nuclear power station.

Reference: International Journal on Earthquake Engineering and Structural Dynamics, in press.

A PRACTICAL SYSTEM FOR ISOLATING NUCLEAR POWER PLANTS FROM EARTHQUAKE ATTACK

by R. I. Skinner, G. N. Bycroft, and G. H. McVerry

The earthquake-generated forces and deformations of the main substructures of a nuclear power plant can be reduced by a factor of about 10 times by mounting the power plant building on a recently developed base-isolation system.

The very high forces that the "resonant appendage" effect may induce in some critical components (such as fuel elements and control rods) may be reduced by a factor of 40 or more by the isolation system. This system combines recently developed hysteretic dampers with components that support the structure while providing high flexibility for horizontal motion. These dampers utilize the plastic deformation of solid steel beams, while a convenient support system with adequate horizontal flexibility may be provided by laminated rubber bearings of the type frequently used to support bridge decks.

The earthquake attack on a nuclear power plant is particularly hazardous since it simultaneously attacks all the plant components, including the control and safety systems. Undetected deterioration of a set of components may further increase the probability of a multiple-failure during earthquakes. Hence the large reduction in earthquake-induced forces and deformations, which may be achieved with the base-isolation system described, will greatly reduce the likelihood of earthquake-induced accident or damage in those nuclear power plants located in regions of high seismicity.

Reference: Nuclear Engineering and Design, in press.

DATA REPORTS AND AVAILABILITY OF DIGITIZED DATA

By A. G. Brady

The strong-motion records from the February 9, 1971 San Fernando earthquake and most of the significant records prior to that event have been digitized by the California Institute of Technology (CIT). The processing and analysis of that data has been presented in a series of reports containing 1) uncorrected digital data, 2) corrected accelerations, velocities, and displacements, 3) response spectra, and 4) Fourier amplitude spectra.

The digitizations and analysis of the significant records subsequent to the San Fernando earthquake have been carried out by the USGS. A report containing the digital data and spectra for the remainder of the records collected in 1971 is ready for publication. Similar reports for records obtained in subsequent years are also in preparation. Estimates of the publication dates for these reports are as follows:

Records from 1971:	June 1976
Records from 1972:	October 1976
Records from 1973:	December 1976
Records from 1974:	March 1977
Records from 1975:	June 1977

Table 2 presents a list of the records to be contained in each of these data reports.

The digitized data from the CIT digitization program are available from the Environmental Data Service (EDS) in the forms indicated below. The digital data from the subsequent years will be transferred to EDS for dissemination as soon as it has been verified, and should be available from them at approximately the same time as the data reports are published.

* Volume I form of data (uncorrected) is available in punched card form (about 2000 cards each) for $20 per event and on magnetic tape (seven- or nine-track) for $60 per tape. The complete file of approximately 400 records is available on six magnetic tapes for $360.
* Inquiries should be addressed to:

National Geophysical and Solar-Terestrial Data Center
Code 62
EDS/NOAA
Boulder, CO 80302
(303) 499-1000, ext. 6472

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Table 1 - *Summary of accelerograph records: January - March 1976*

Event	Station location		S-t time[1]	Comp	Max accl[2]	Duration[3]
	Name	Coord	(sec)		(g)	(sec)
1 January 1976	Brea Dam	33.89N	2.1	N50W	.09	
0920 PST	Crest	117.93W		Down	.06	
So. California				S40W	.13	0.2
33.58N, 117.53W	Brea Dam	33.89N	1.8	N50W	.10	1 peak
Magnitude 4.2	Downstream	117.93W		Down	.06	
				S40W	.06	
	Brea Dam	33.89N	Instrument was inoperative			
	Abutment	117.93W				
	Carbon Canyon Dam	33.92N	1.7	N50W	.08	
	Crest	117.84W		Down	.05	
				S40W	.12	0.5
	Carbon Canyon Dam	33.92N	1.7	N50W	.10	1 peak
	Right abutment	117.84W		Down	.04	
				S40W	.14	0.3
	Carbon Canyon Dam	33.92N	1.7	N50W	.13	1 peak
	Left abutment	117.84W		Down	.06	
				S40W	.14	0.2
	Diemer Filter Plant	33.91N	1.6	S79E	.02	
	Basement	117.82W		Down		
				N11E		
	Diemer Filter Plant	33.91N	1.7	N79E		
	Reservoir	117.82W		Down		
				N11W	.07	
	Orange County	33.94N	1.5	N84W	.18	0.1
	Reservoir	117.88W		Down	.06	
	Abutment			S06W	.08	
	Whittier	33.97N	2.5	North	.06	
	7215 Bright Avenue	118.04W		Down	.07	
	Basement			West	.17	0.2
	Whittier	33.97N	2.5	North	.07	
	7215 Bright Avenue	118.04W		Down	.10	0.1
	5th floor			West	.28	0.6
	Whittier	33.97N	2.5	North	.04	
	7215 Bright Avenue	118.04W		Down	.12	0.3
	10th floor			West	.19	0.7
3 February 1976	One record (max accel .04 g) was obtained at the					
1705 MST	Prescott VA hospital.					
Central Arizona						
34.70N, 112.53W						
Magnitude 5.0						

See footnotes at the end of the table.

Table 1 - *Summary of accelerograph records: January - March 1976* - Continued

Event	Station location		S-t time[1]	Comp	Max accl[2]	Duration[3]
	Name	Coord	(sec)		(g)	(sec)
4 February 1976 0902 GCT Guatemala 15.27N, 89.25W Magnitude 7.5	Two seismoscope records were obtained from the 4-story administration building at the University in Guatemala City, one from ground level and one from the roof.					
18 February 1976 0359 (Local time) Guatemala Loc and mag unknown	IBM building Ground level	14.64N 90.51W		South Down East	.10	1 peak
1 March 1976 1730 (Local time) Managua Loc and mag unknown	One record was obtained at Chinandega (ground level) with a maximum horizontal acceleration of .05 g.					
24 March 1976 1841 CST NE Arkansas 35.5N, 90.5W Magnitude 4.7-5	7 minor records (less than 0.05 g) were obtained: 3 from Arkabutla Dam, Mississippi; 2 from Wappapello Dam, Missouri; 1 from New Madrid, Missouri; and 1 from Tiptonville, Tennessee.					
30 November 1975- 22 March 1976 Kilauea, Hawaii Loc and mag unknown	Kilauea, Hawaii Namakani Paio	19.43N 155.30W		S30W Down S60E	.05 .03 .05	
	Kihauea, Hawaii Namakani Paio	19.43N 155.30W		S30W Down S60E	.06 .03 .05	
	Kilauea, Hawaii Namakani Paio	19.43N 155.30W		S30W Down S60E	.04 .04 .06	

[1] S-wave minus trigger time.

[2] Unless otherwise noted, maximum acceleration recorded at ground or basement level. Data from the records are summarized only if the maximum acceleration is greater than 0.05 g at ground stations or greater than 0.10 g at upper floors of buildings.

[3] Duration for which peaks of acceleration exceed 0.10 g.

Table 2 - *Records being processed for data reports*

Date of Event	Station Location	Maximum Accel (1) (g)
	1971	
March 8, 1971	Isabella Auxiliary Dam; abutment	0.11
May 1, 1971	Adak, Alaska; US Naval Base	0.19
July 9, 1971	Santiago, Chile; University of Chile	0.18
September 12, 1971	Ferndale, California; Old City Hall	0.10
November 29, 1971	Lima, Peru; Geophysical Institute	0.09
	1972	
January 3, 1972	Managua, Nicaragua; Esso Refinery	0.15
January 5, 1972	Managua, Nicaragua; Esso Refinery	0.22
	Managua, Nicaragua; National University	0.12
March 4, 1972	Bear Valley, Calif.; Melendy Ranch barn	0.15
March 22, 1972	Bear Valley, Calif.; Melendy Ranch barn	0.16
July 30, 1972	Sitka, Alaska; Magnetic Observatory	0.11
August 27, 1972	Beverly Hills, Calif.; 8383 Wilshire (2)	0.15
	Beverly Hills, Calif.; 9100 Wilshire (2)	0.12
	Los Angeles, Calif.; 6300 Wilshire (2)	0.10
	Los Angeles, Calif.; 6420 Wilshire (2)	0.15
September 4, 1972	Bear Valley, Calif.; CDF Fire Station	0.18
	Bear Valley, Calif.; Melendy Ranch barn	0.48
	Bear Valley, Calif.; Stone Canyon East	0.18
December 23, 1972	Managua, Nicaragua; Esso Refinery	0.39
Aftershock B	Managua, Nicaragua; Esso Refinery	0.17
Aftershock C	Managua, Nicaragua; Esso Refinery	0.32
	1973	
February 21, 1973	Port Hueneme, Calif.; U.S. Naval Laboratory	0.13
March 31, 1973	Managua, Nicaragua; National University	0.60
April 26, 1973	Kilauea, Hawaii; Namakani Paio Campground	0.17
August 8, 1973	Ferndale, Calif.; Old City Hall	0.14
September 16, 1973	Berryessa, Calif.; CDF Fire Station	0.18
	1974	
January 5, 1974	Lima, Peru; Zarate Station	0.16
	Lima, Peru; Geophysical Institute	0.11
January 31, 1974	Gilroy, Calif.; Gavilan College, Bldg 10	0.16
February 11, 1974	Los Angeles, Calif.; 420 S. Grand (2)	0.10
	Los Angeles, Calif.; 525 S. Flower, No. Tower (2)	0.13
	Los Angeles, Calif.; 700 W. 7th (2)	0.18
	Los Angeles, Calif.; 533 S. Fremont (2)	0.25
	Los Angeles, Calif.; 420 S. Grand (2)	0.10
August 14, 1974	Pacoima Dam, abutment	0.12
	Vasquez Rocks Park, Calif.	0.10
October 3, 1974	Lima, Peru; Dr. Huaco residence	0.18
	Lima, Peru; Geophysical Institute	0.21
November 9, 1974	Lima, Peru; La Molina Station	0.14
November 28, 1974	Hollister, Calif.; City Hall	0.17
	San Juan Bautista, Calif.; 24 Polk St.	0.12
	Gilroy, Calif.; Gavilan College Bldg 10	0.14
December 6, 1974	Imperial, Calif.; Imperial Valley College Adm. Bldg.	0.11

See Footnotes at end of table.

Table 2 - *Records being processed for data reports* - Continued

Date of Event	Station Location	Maximum Accel (1) (g)
	1975	
January 11, 1975	Petrolia, Calif.; General Store	0.10
	Cape Mendocino,Calif.; Petrolia	0.19
January 23, 1975	Imperial, Calif.; Imperial Valley College Adm. Bldg.	0.11
March 6, 1975	Bear Valley, Calif.; Melendy Ranch East	0.18
May 6, 1975	Shelter Cove, Calif.; Station 2 Power Plant Yard	0.18
June 7, 1975	Ferndale, Calif.; Old City Hall	0.19
	Cape Mendocino, Calif.; Petrolia	0.22
	Petrolia, Calif.; General Store	0.19
	Shelter Cove, Calif.; Station 2 Power Plant Yard	0.10
June 19, 1975	El Centro Array, Calif.; Station 6, 551 Huston	0.10
June 20, 1975	El Centro Array, Calif.; Station 6, 551 Huston	0.13
	Holtville, Calif.	0.15
August 1, 1975	Oroville Dam, Calif.; Crest	0.13
	Oroville Dam, Calif.; Seismograph Station	0.11
August 2, 1975	Pleasant Valley Pumping Plant, Calif.	0.08
	Pleasant Valley, Calif.; Switchyard	0.13
September 13, 1975	Parkfield Grade, Calif.; Jack Varian Ranch	0.14
	Vineyard Canyon, Calif.	0.18
November 14, 1975	Ferndale, Calif.; Old City Hall	0.18
	Cape Mendocino, Calif.; Petrolia	0.13
	Petrolia, Calif.; General Store	0.10
November 29, 1975 0335 (Local time)	Hilo, Hawaii; UH Cloud Physics Lab.	0.15
November 29, 1975 0447 (Local time)	Honokaa, Hawaii; Central Service Bldg.	0.11

(1) Maximum acceleration at ground or basement level.
(2) The records from the upper levels of these buildings are being digitized also.

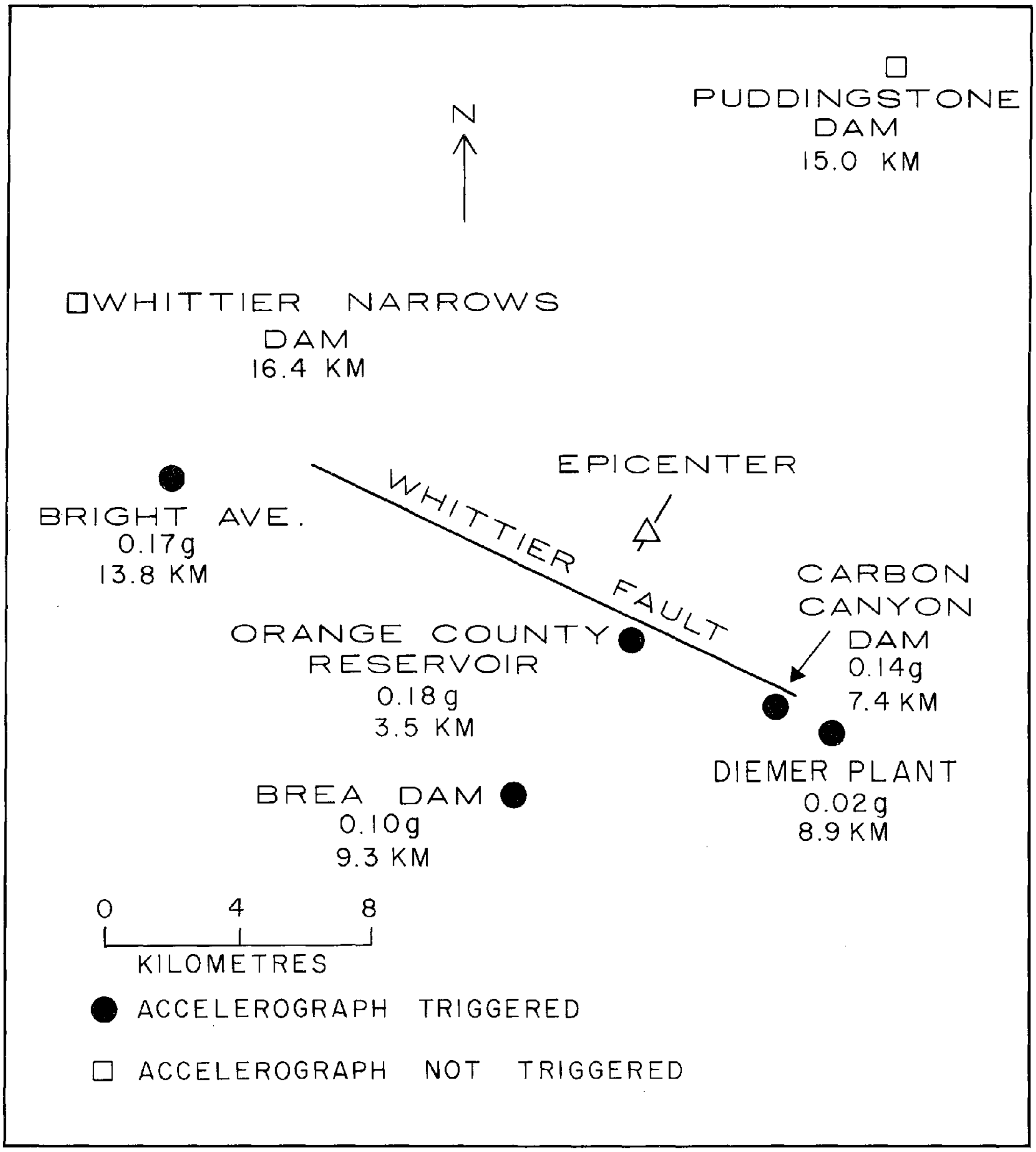

Figure 1.- Accelerograph stations in the vicinity of the January 1 earthquake. Maximum ground level accelerations and epicentral distances are shown below station names.

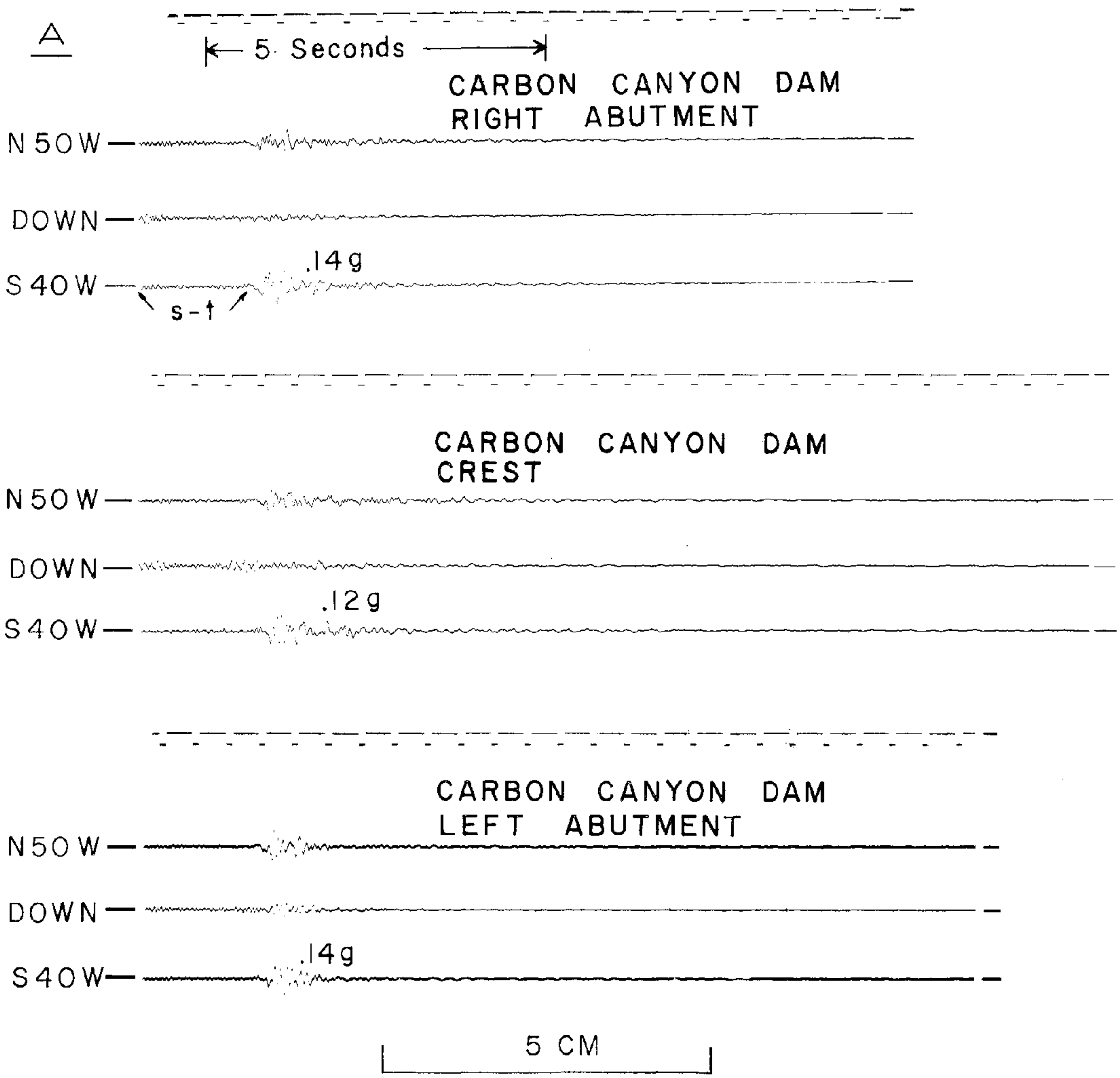

Figure 2.- Accelerograph records from the southern California earthquake of January 1, 1976 (Magnitude 4.2).

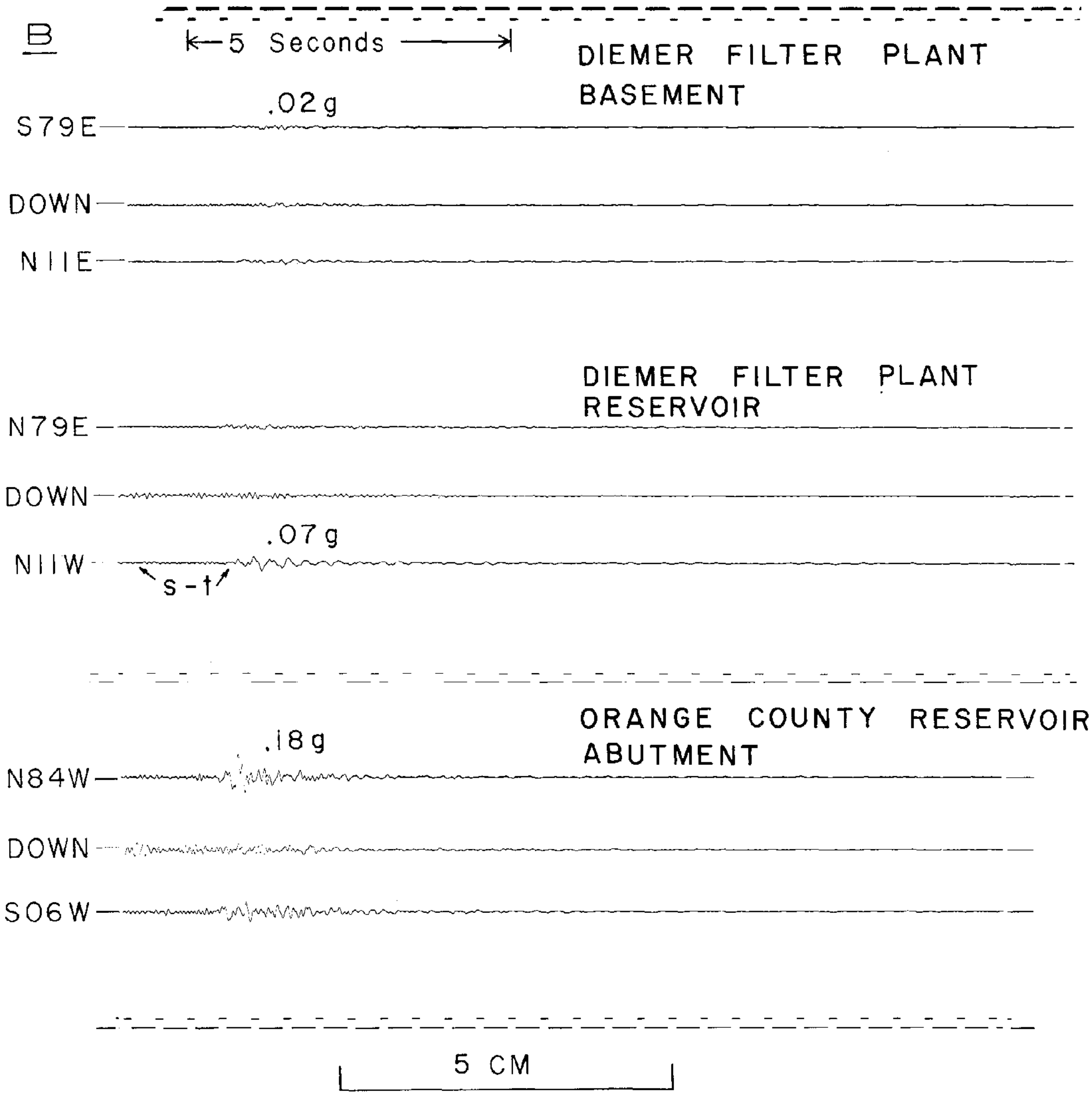

Figure 2.- Continued.

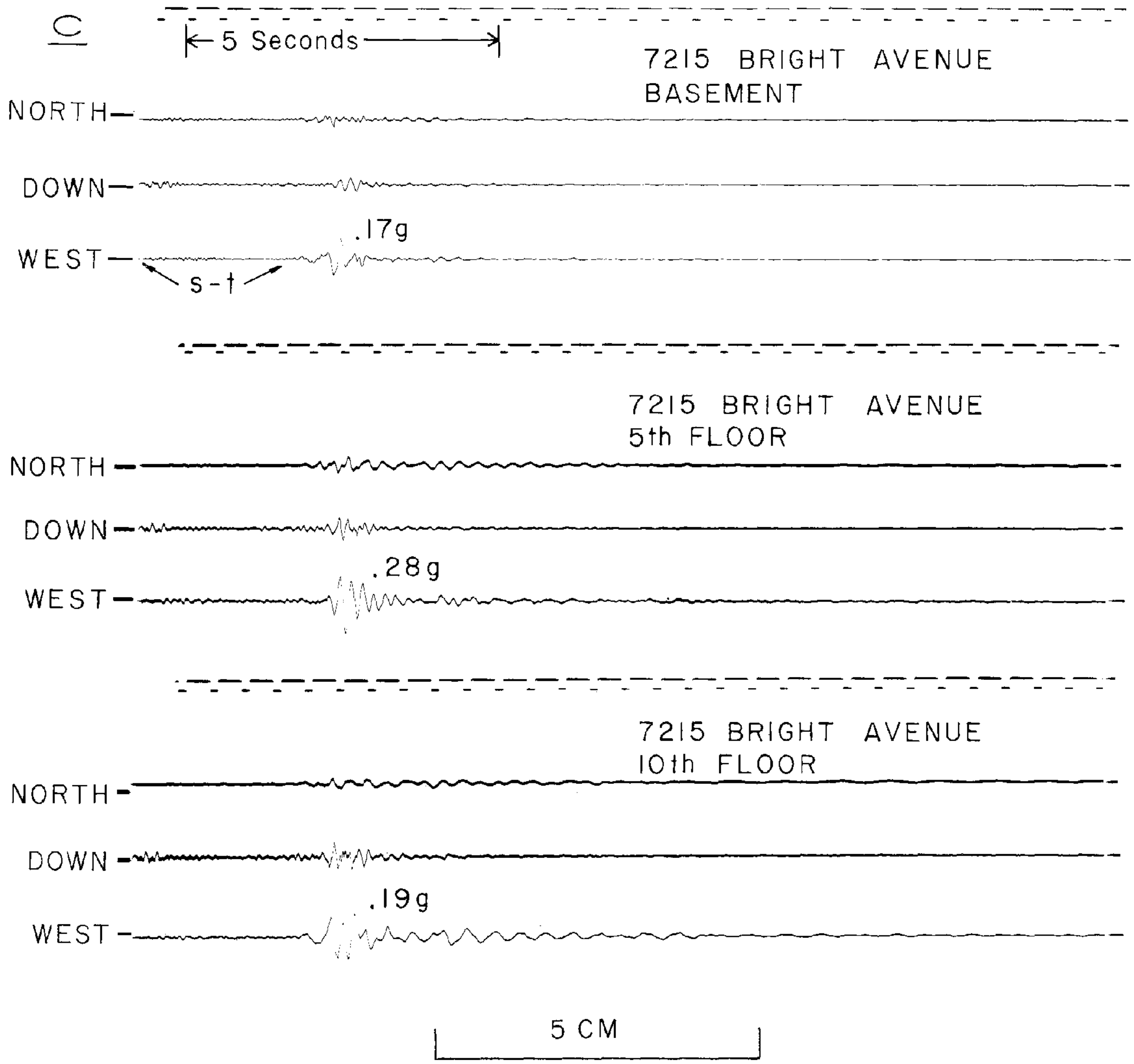

Figure 2.- Continued.

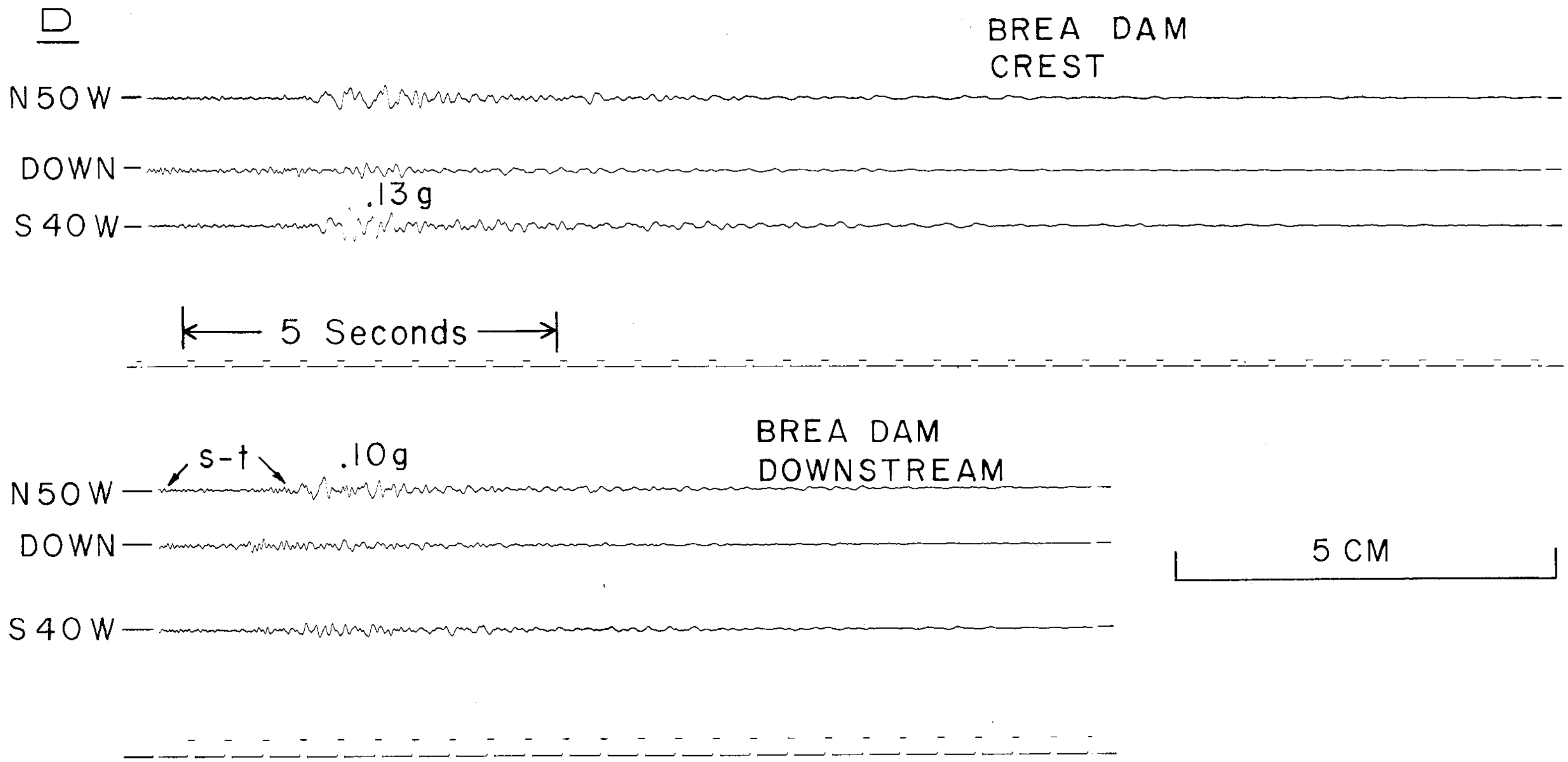

Figure 2.- Continued.

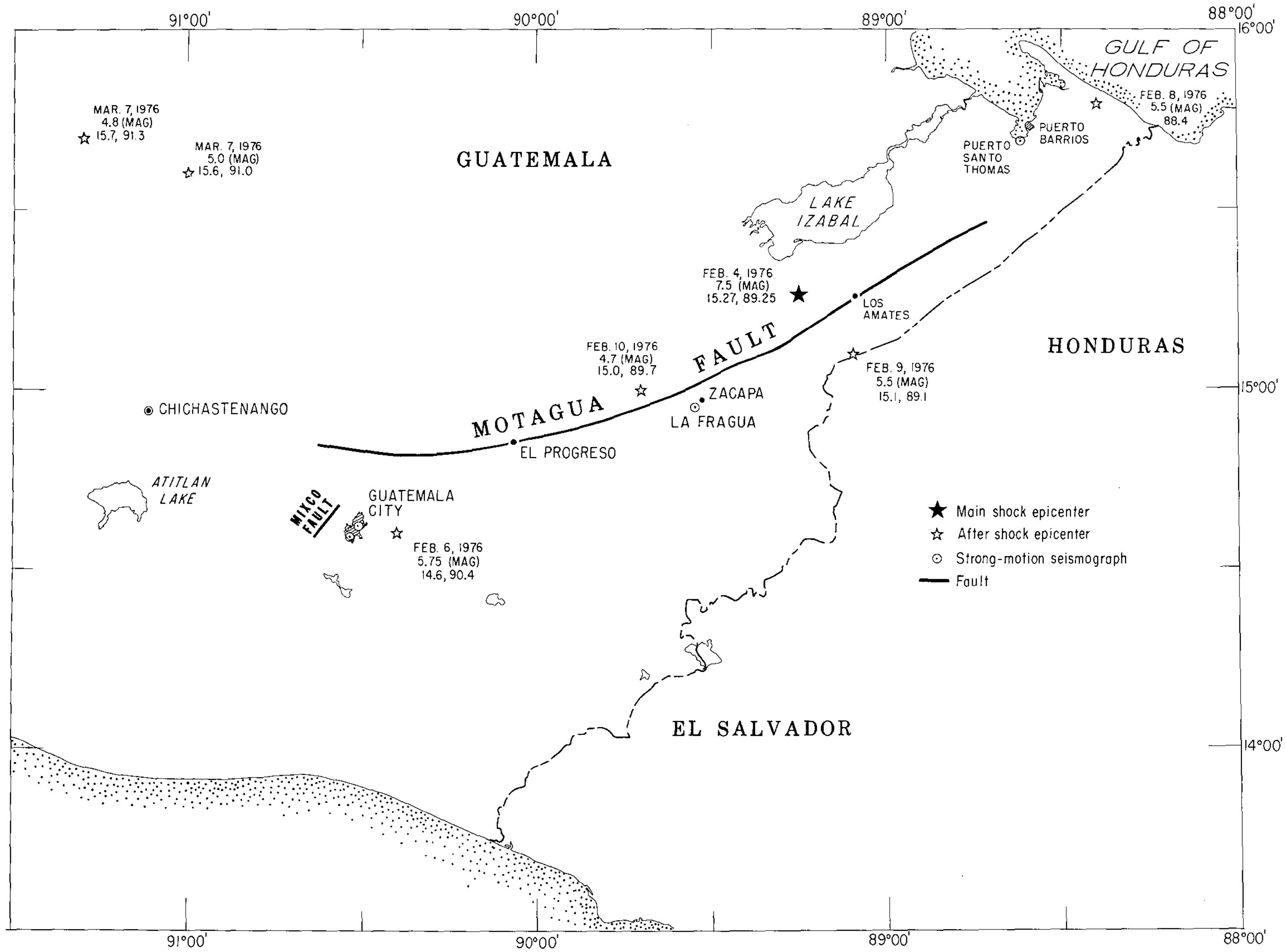

Figure 3.- Locations of February 4, 1976 Guatemala earthquake and aftershocks.

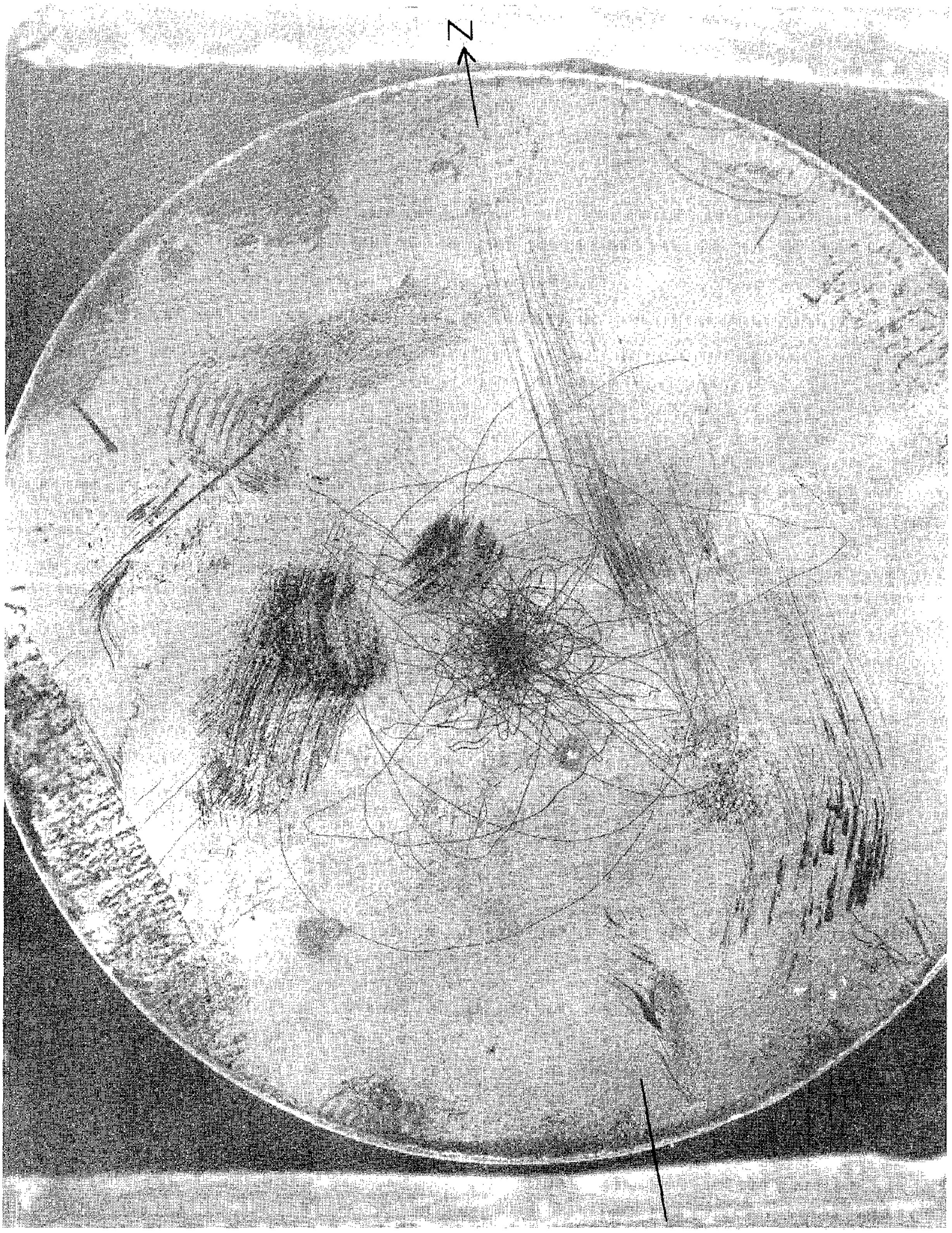

Figure 4.- Seismoscope plate from University Administration Building ground floor location - 3X enlargement.

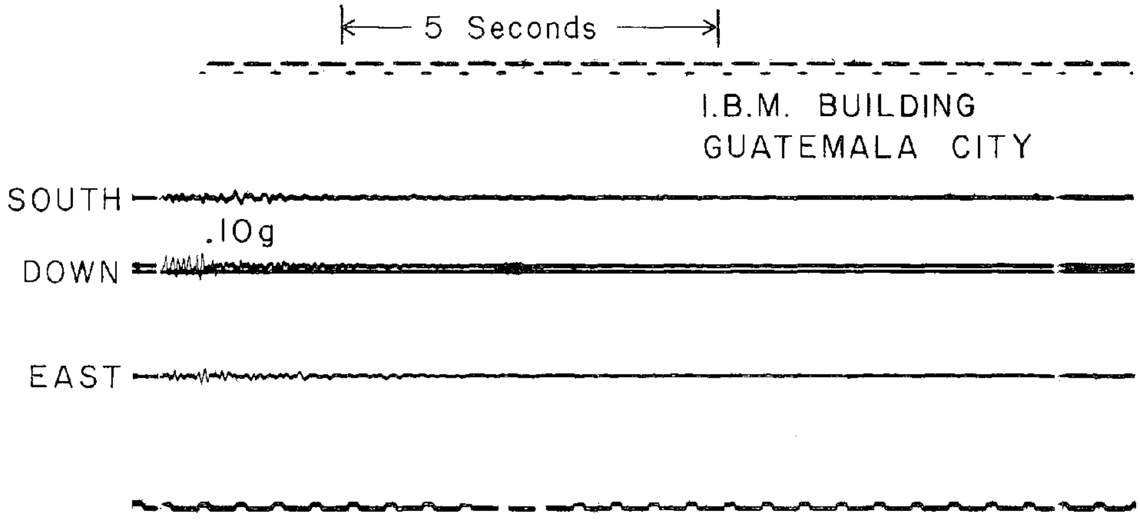

Figure 5.- IBM Building accelerograph record of Guatemala aftershock, February 18, 1976.

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