STRONG-MOTION RECORDINGS OF THE MAIN EVENT AND FEBRUARY 18 AFTERSHOCK

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INTRODUCTION

The seismic history of Guatemala includes many destructive earthquakes (Person and others, this report). In 1773, the former capital, Antigua, was destroyed. A series of earthquakes beginning on November 17, 1917, and continuing with shocks on December 25 and 29 and also on January 3 and 24, 1918, destroyed Guatemala City. In the last 50 years, Guatemala has felt many strong earthquakes, but, until the series in February, none were of sufficient magnitude to cause the destruction experienced in the past.

Two strong-motion accelerographs and three seismoscopes were located in Guatemala City at the time of the February earthquakes. One accelerograph, an RFT–250, had not been reinstalled following repairs. The second accelerograph, a Montana type, was operational, but the lamp burned out at the time of the earthquake. The only records obtained were from the two seismoscopes, which were installed at the Universidad de San Carlos.

SEISMIC INSTRUMENTATION

The first useful seismograms from Guatemala were obtained in March 1919 from the Wiechert instruments donated to Guatemala by Georgetown University. These instruments, two horizontal and one vertical, have registered 20 to 39 shocks annually since initial installation. The seismic station of the Observatorio Nacional is a three-story 9.9 × 13.7-m building. There is one story below ground level and two above. The portion of the building below ground level and the first story above ground level are of concrete frame with brick-filler walls. The third story is of wood frame construction. The first and second stories of the building serve to house a second building, or vault, that is built of concrete framing with brick-filler walls and is the seismograph and accelerograph vault In May 1947, the 30-cm Montana-type accelerograph was installed. Numerous records have been obtained since installation of this accelerograph, but none have been of any engineering significance.

The Centro de Investigaciones de Ingeniería of the Universidad de San Carlos purchased one RFT–250 accelerograph and three seismoscopes in the late 1960's. Two of the seismoscopes were installed in the administration building of the university, one on the ground floor and the second on the roof. The other seismoscope was installed in the Engineering Laboratory Building but was not deployed at the time of the February earthquakes. It was removed early in 1975 and taken to the Observatorio Nacional for repair. Although repaired and operational in July of 1975, it had not been reinstalled when the February earthquakes occurred.

Four SMA–1 accelerographs were sent to Guatemala by the U.S. Geological Survey after the main event. In view of the distribution of the epicenter locations for the February 6, 8, 9, and 10 earthquakes, along with a fault length of more than 240 km (Plafker and others, this report) on the Motagua fault and secondary faulting in the Mixco area, it was decided to deploy the SMA–1 accelerographs at Puerto Santo Tomás, Zacapa, and Chichicastenango. An additional accelerograph and a seismoscope were later deployed in the center of Guatemala City at the IBM building (fig. 15). These four accelerographs were installed as temporary aftershock strong-motion instruments, and they will be removed in 2 or 3 months.

SEISMOSCOPE RECORDS OF MAIN EVENT

The two seismoscope records were recovered on February 10, 1976. The administration building at the university is a four-story building with dimensions of 29.76×59.46 m. The seismoscope plate (fig. 16) from the instrument on the roof of the building

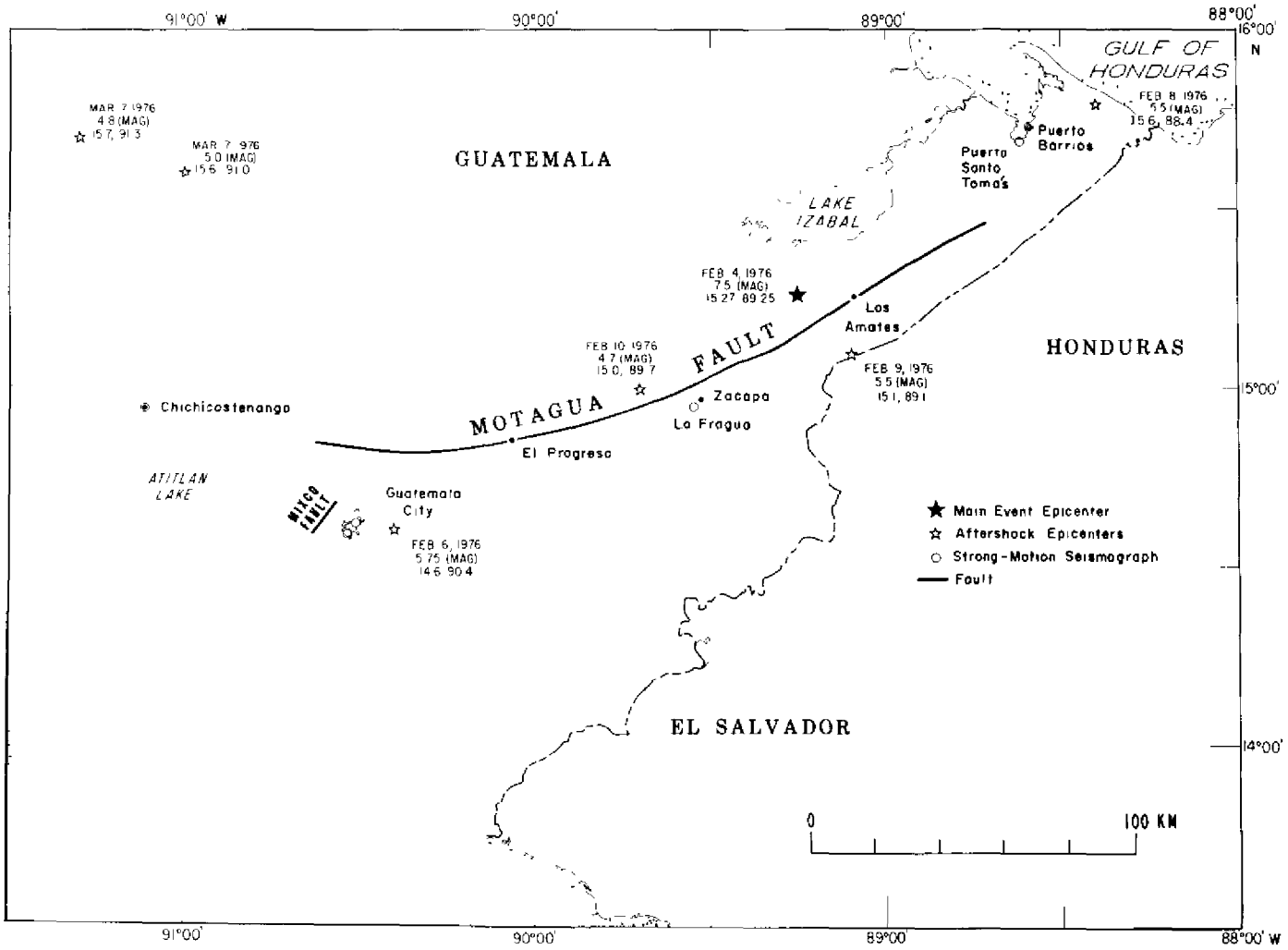

FIGURE 15.—Strong-motion field network, surface fault breakage (Plafker and others, this report), and epicenters of main event and aftershocks. Date, magnitude, and location are given for each (Person and others, this report).

had been dislodged. The ground motion on this record exceeded the maximum radius of the plate before it was dislodged. The trace on the seismoscope plate of the ground floor (fig. 17) had a maximum relative displacement of $S_0 = 5.3$ cm for $T_1 = 0.78$ s, and a 10-percent damping.

Two sections of the maximum excursions of the recorded motion on the ground-floor seismoscope were analyzed in order to recover the levels of ground accelerations. Part of the trace between the two analyzed sections could not be followed, but it is certain that section one was first real time. The following constants were used in the analysis of the deconvolution of the seismoscope plate: $T_1 = 0.78$ s (natural period of seismoscope), $T_2 = 0.055$ s (second harmonic of seismoscope), and S = 5.8 cm/rad, (sensitivity of seismoscope). The T_2 and S values are average determinations obtained from similar seismoscopes, and the other constants were obtained in the field calibration of these instruments.

The results of the above analysis are shown in figures 18 and 19. These two figures show the acceleration as a function of time for the north and east direction of motion. The first section was followed for 2 s, and the second section for 5 s. Maximum accelerations as shown are about 200 gals. A 600-gal acceleration appeared on the north directional component at approximately 1 s after the beginning of the second section. Unfortunately, there is insufficient recoverable trace length, and hence the data available do not warrant a spectral-analysis evaluation, since the time window is very short.

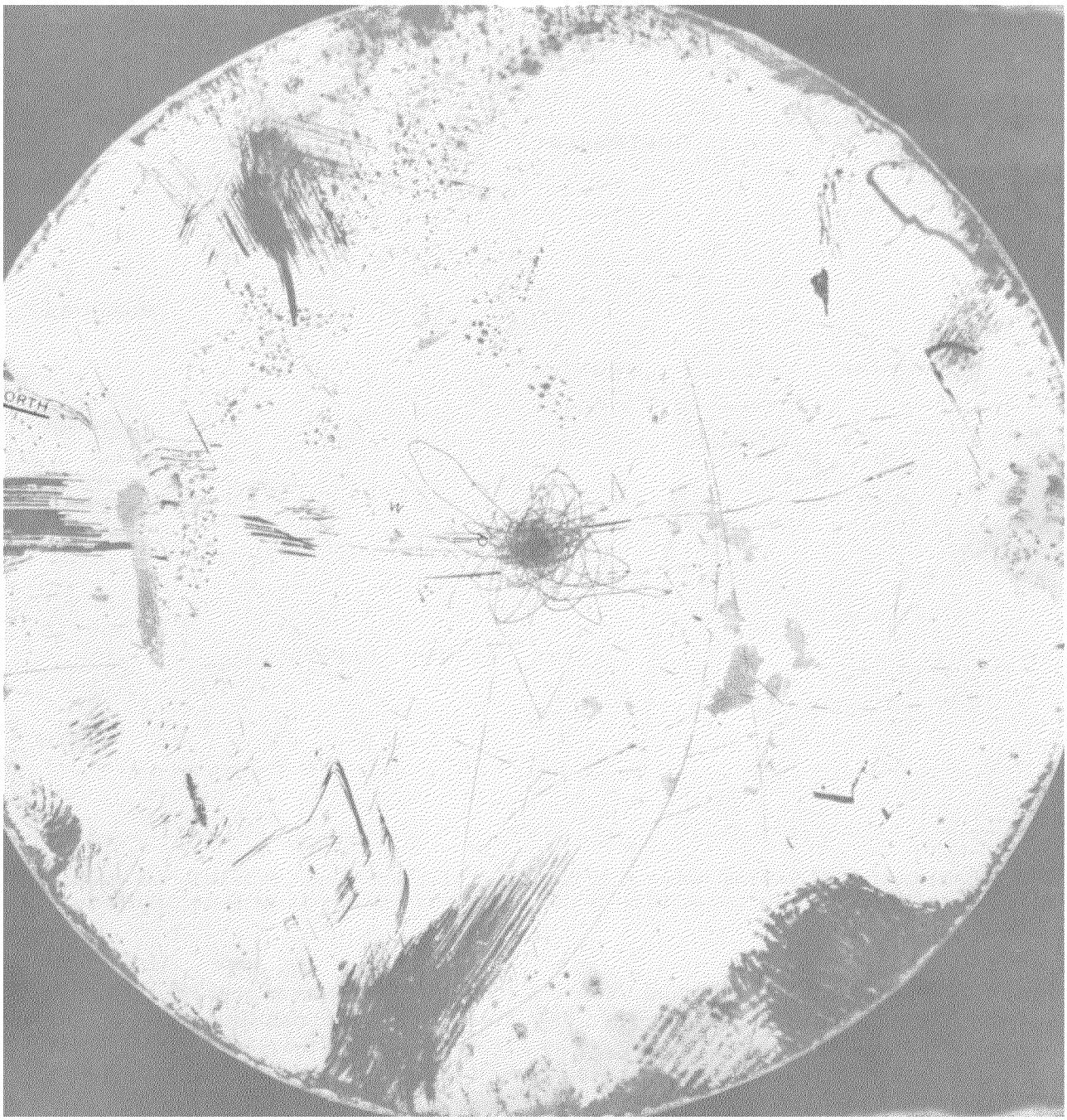

FIGURE 16.—Seismoscope plate of main event located on a rooftop instrument at the administration building of the Universidad de San Carlos, Guatemala City. Instrument was about 30 km south of Motagua fault surface breakage. Arrow indicates north. The plate is scratched all over. Recording of main event is shown in the middle part of plate and to the sides before dislodging.