

# Some aspects of the seismicity associated with the 1982 eruption of El Chichon Volcano, Chiapas, Mexico

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## Abstract

We review the different phases of the seismicity related to the 1982 eruption of El Chichon Volcano, Chiapas, Mexico. The pre-eruption seismicity was already anomalous by late 1980, became significant by late 1981 and increased towards 28 March, 1982, when the first eruptive event occurred. A noticeable feature within the 7-day period of unrest is the occurrence of three earthquake swarms before the devastating explosions of 3 and 4 April 1982 (local time). The periodicity and appearance of the swarms, close to the time of maximum tidal strain, suggests a large overpressure in the magmatic system, and the triggering of the events by the earth tides. The post-eruption seismicity occurred mostly in a radius 5 km from the crater and a depth range 11 to 15 km suggesting that this region was a deeper reservoir of the erupted magma.

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## 1. Introduction

On March 28, 1982 at 23:32 h local time, El Chichon Volcano, Chiapas, southern Mexico (17°22'N, 93°14'W; 1100 masl; Fig. 1) erupted producing a plinian column exceeding 20 km in height (Carey and Sigurdsson, 1986). Two major explosions on April 3 (GMT), with plinian columns that also intruded the stratosphere, produced widespread pyroclastic flows and surges that killed an unknown number of persons, probably more than 2000 (e.g. Báez-Jorge et al., 1985). Although the seismic premonitory activity lasted for several months,

the eruption with its different phases lasted only 7 days while the seismicity continued for about 4 weeks with the number of earthquakes decreasing to almost normal levels after this period (Jimenez et al., 1999). The seismic activity was recorded by a nearby seismograph network deployed to monitor dam impounding, and temporal networks setup after the first explosion. The broad features of the seismicity were reported soon after the eruption (Havskov et al., 1983), and the results of more detailed analyses some time afterwards (Medina et al., 1988; Yokoyama et al., 1992; Jimenez et al., 1999). In this paper we report on some other features of the seismicity not addressed before. In particular we examined the occurrence of three earthquake swarms that occurred before the last two climactic explosions of April 1982.

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## 2. Seismic data

The seismic data used in the analyses presented herein were obtained from the ink-on-paper seismograms produced by the instruments from the Chicoasen permanent network, and the smoked paper seismograms from the temporary seismic networks installed soon after the 28 March explosion by researchers from the Institutes of Geophysics and Engineering of the National Autonomous University of Mexico (UNAM). The Chicoasen network was installed by Comisión Federal de Electricidad (CFE), the national power company, during the second half of 1979 to monitor impounding of Chicoasen dam, and it became fully operational in January 1980. Yokoyama et al. (1992) and Jimenez et al (1999) gave full details of the characteristics of the instruments from these networks. Jimenez et al. (1999) analyzed the records from these sources and created a database containing 1550 located earthquakes, their polarity when it was clear and unambiguous, and coda magnitudes. In this database, hypocenters and magnitudes were calculated using HYPO-71PC (Lee and Lahr, 1978) and the velocity

Table 1

Velocity model for hypocenter determination

P-wave velocity (km/s)	Top of layer (km)
4.6	0
5.4	1.5
5.65	3.0
6.00	8.0
6.30	15.0
7.60	2.8

model shown in Table 1 estimated from geologic data of Canul and Rocha (1981). The model was tested with 30 selected post eruption events recorded by at least 10 stations. These events provide good control because they have impulsive arrivals and well-defined phases. Table 2 shows the number of events located at different periods together with their RMS arrival time errors and the uncertainties in their horizontal and vertical location (ERH and ERZ). Coda magnitudes were obtained through formula  $M_c = -0.87 + 1.86 \log T$ , where  $T$  is event duration in s. This relationship was determined for a neighboring region in the State of Oaxaca by González-Ruiz (1980).

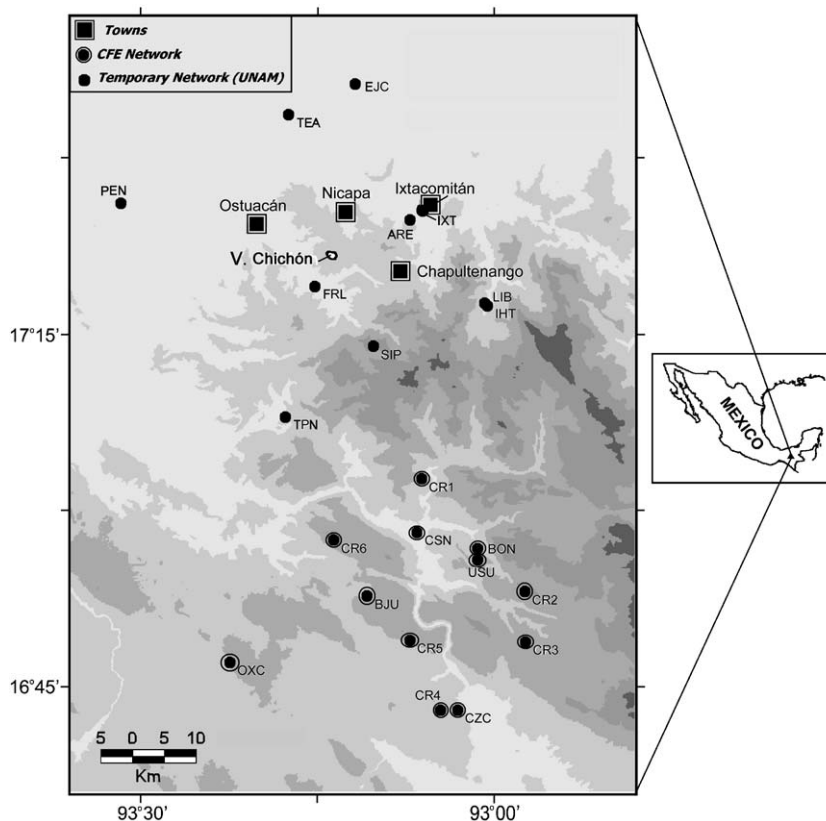


Fig. 1. Location of El Chichon and seismograph stations in 1982.

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