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Short Contribution

A C-14 AGE DETERMINATION IN THE TACANA VOLCANO (CHIAPAS, MEXICO)

J. M. ESPINDOLA*
F. M. MEDINA*
M. DE LOS RIOS**
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RESUMEN

Se colectaron varias muestras de madera carbonizada de un depósito de flujo piroclástico en el lado mexicano del volcán Tacaná (situado en la frontera entre México y Guatemala). Damos una breve descripción del sitio donde fue encontrado el carbón y los resultados del análisis por C-14, que dio para las muestras una edad de más de 42 000 años.

ABSTRACT

Several samples of carbonized wood were collected from a pyroclastic flow deposit on the Mexican side of the Tacaná Volcano (located in the border between México and Guatemala). We give a brief description of the site where the charcoal was found, and the results of the C-14 analysis which yield an age for the samples of more than 42 000 years.

* *Instituto de Geofísica, UNAM, Ciudad Universitaria, México, D. F., 04510, MEXICO.*

** *Depto. de Prehistoria, Instituto Nacional de Antropología e Historia, Moneda 16, México, D. F., 06060, MEXICO.*

INTRODUCTION

During the months of December, 1985 and January and February, 1986, a series of earthquakes occurred at the NE of the Tacaná volcano in the border between Mexico and Guatemala. Following this activity, the area around the volcano continued to show activity predominantly of the A type (Minakami, 1974) accompanied frequently by acoustic signals. On May 7, an earthquake swarm with epicenters on the SW flank of the volcano was followed by a phreatic explosion which opened a crater of a few tens of meters on the NW flank of the volcano at an altitude of 3 100 m above mean sea level (amsl), creating a fumarole which to this moment is still present (De la Cruz-Reyna *et al.*, 1986).

The alarm caused by these events prompted a series of observations from researchers of the Institute of Geophysics at the National Autonomous University of Mexico (De la Cruz-Reyna *et al.*, 1986; Segovia *et al.*, 1986; Mena *et al.*, 1986). Within this framework we made a preliminary reconnaissance of some pyroclastic deposits of previous eruptions. In one of them we were able to obtain carbonized wood samples which were later dated by C-14 methods.

GEOLOGIC SETTING AND PREVIOUS HISTORIC ACTIVITY

The Tacaná volcano is located at the border between Guatemala and Mexico, in the State of Chiapas in southern Mexico (15°08'N, 92°09'W; Figure 1). The most recent studies in this region have been carried out by geologists of the Federal Commission of Electricity (CFE) as part of their research on the geothermal areas of Mexico. Figure 2 shows the geology of the area, according to De la Cruz and Hernández (1985). The volcanic structure rises some 2 200 m (4 110 m amsl) over a granitic basement of Paleozoic age and is crowned by three small caldera structures representing different stages of eruptive activity. The first rim is an oval-shaped caldera of about 2 by 3 km at an altitude of 3 600 m amsl.

The second one, lying within the first one, is similarly oval-shaped with axes of about 1.5 by 1 km. The present crater, with an andesitic dome and a radius of about half a kilometer, emerges from these structures. The volcanic edifice shows small adventice craters towards the W-SW of the summit with diameters ranging between 150 and 40 m.

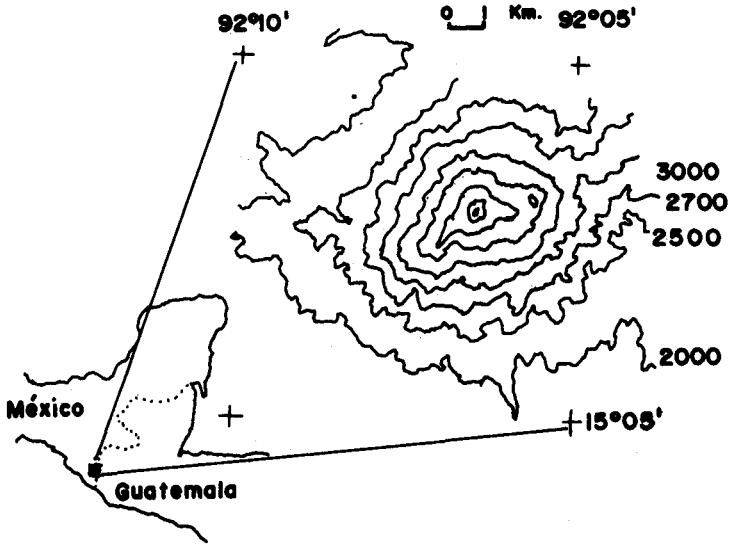

Fig. 1. Location of Tacaná volcano.

Little information is available on the historic activity of the volcano. Böse (1903) reports, from accounts of the inhabitants of the region, the occurrence of ash emissions in 1855 and 1878. In 1949 and 1950 the volcano resumed fumarolic and seismic activity. A wide area at the southwest of the summit developed fumaroles and solfataras in this occasion (Mulleried, 1951).

According to De la Cruz and Hernández (1985) three main Pyroclastic flows can be distinguished in the area. These (Qt_1, Qt_2 and Qt_3) are related to the formation of the three caldera structures and the actual crater. The Tacaná volcano began its existence with the emission of hornblende-augite andesites (Qa_4).

These can be seen at the E and W at 3 600 m asml. The early edifice formed by this emission was destroyed during the episode that gave origin to the pyroclastic flows Qt_3 and the caldera. A new edifice of hornblende andesite rose from this structure (Qa_3). These rocks outcrop clearly at the 3 800 m mark forming the E and W sides of the volcano. A second explosive period destroyed the structure,

formed a new caldera and created the pyroclastic deposits Qt_2. Following the same pattern a new edifice of the same rock was formed (Qa_2) and destroyed during the event that formed the Qt_1 pyroclastic flows and left the 0.5 km diameter crater which was finally plugged by hornblende andesite lava flows of porphyritic texture (Qa_1).

No other paroxismal events developed subsequently but the volcano remains active to this day. The small craters at the W-SW are posterior to the placing of the Qa_1 andesites and their activity was accompanied by intense fumarolic activity as indicated by the area of hydrothermal alteration and the thin layer of ash widely distributed and intermixed with recent soil.

THE CHARCOAL SAMPLES

Formations Qt_1, Qt_2 and Qt_3 comprise units with different characteristics among which pyroclastic and block and ash flows as well as airfall and coignimbrite deposits are conspicuous. The complexity of the stratigraphy suggests that the sequence proposed by De la Cruz and Hernández is either too simple or, alternatively, each one of the explosive episodes consisted of a complex sequence of events. A detailed study of the pyroclastic deposits of the Tacaná volcano has still to be made. In the meanwhile, for the purposes of this short contribution, we resort to the nomenclature of those researchers.

Exposures of Qt_3 can be seen in several places along the road to Unión Juárez. Villagers mine small areas for sand and gravel. In one of these we were able to find carbonized wood (Figure 3). The site is about 3 km to the west of Santo Domingo, in the outskirt of a hamlet named La Trinidad (Figure 2, site A). In this deposit, one can note three distinct units separated by an airfall deposit and a coignimbrite (Figure 4). The flows are unwelded and the maximum size scoria fragments are around 60, 9 and 25 cm long in the upper, middle and lower units, respectively. Lithics are 15, 4 and 50 cm long in the same order. In the lower member, a tree trunk divided in two sections separated by a few centimeters and completely carbonized was found. Samples of both sections were collected and wrapped in aluminum foil to be transported to the laboratory of datation of the National Institute of Anthropology and History in Mexico City.

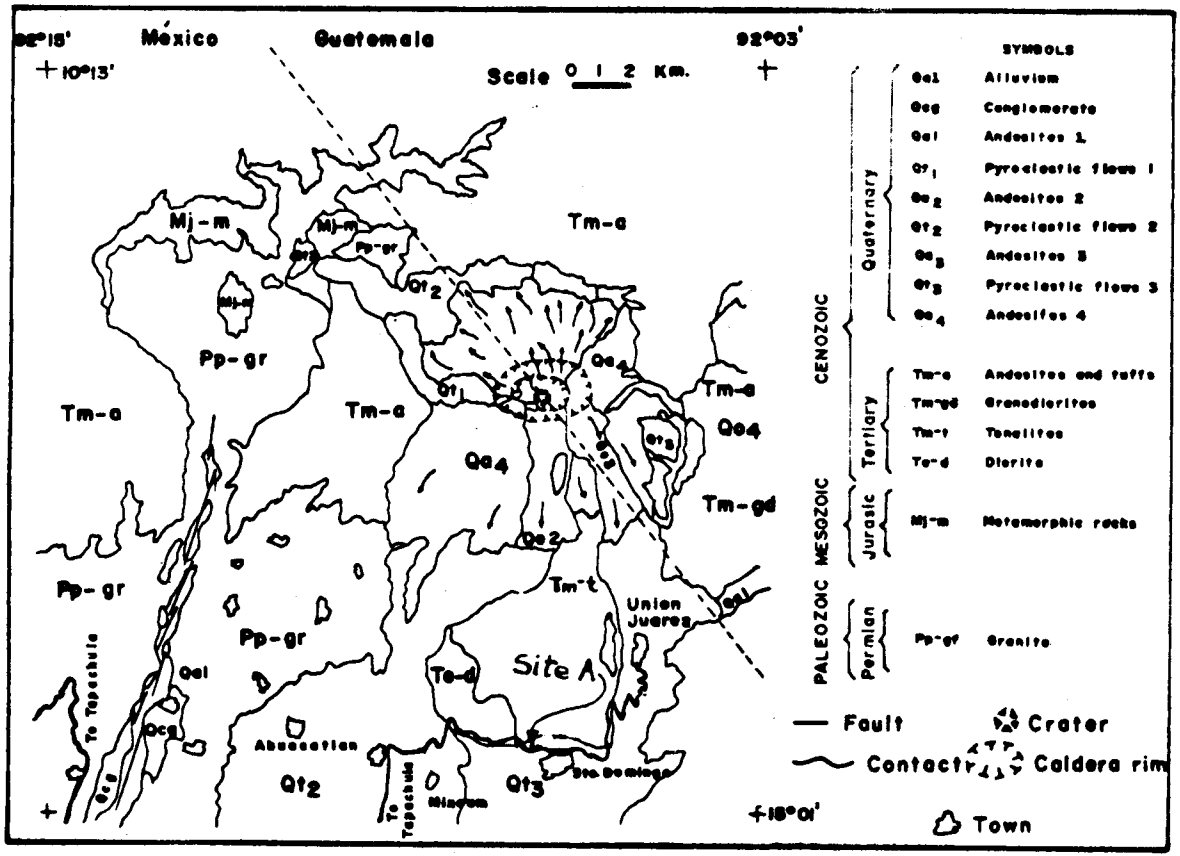

Fig. 2. Geologic map of the area (after De la Cruz and Hernández, 1985).

Fig. 3. Photograph of one of the samples.

The dating of the samples was made by means of the standard techniques of liquid scintillation spectrometry. The elimination of the carbonates was achieved by stirring of the prepared samples in diluted hydrocloric acid. The samples were then heated for several hours at 80°C with a 2% solution of sodium hydroxide to eliminate organic compounds. Cleansing of the samples after each operation was done with bidistilled water.

Transformation to bencene after the pretreatment was obtained through the following reactions:

$$2Li + 2C \xrightarrow{\Delta} Li_2C_2$$

$$Li_2C_2 + H_2O \longrightarrow C_2H_2$$

$$3\,C_2H_2 \xrightarrow[\Delta]{Al_2O_3,\,SiO_2:Cr} C_6H_6$$

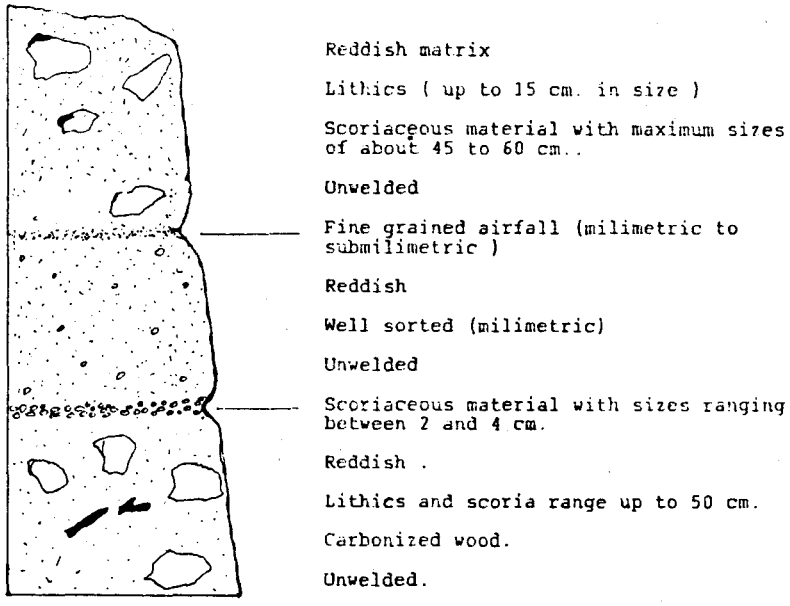

Fig. 4. Simplified stratigraphic column at the site where the samples were collected.

The specific activity of the bencene was measured by means of a Packard model 3255 liquid scintillation spectrometer. The mass of the bencene was determined with an accuracy of a hundredth of a gram.

The two samples, which were treated separately, yield ages of about 42 000 radiocarbon years; however, their specific activity is only slightly different from the background activity. The substraction of the standard deviation of the ratio between the specific activities of the standard and the sample, from the ratio itself, yields a negative value. Therefore one can conclude that the age of the samples is greater than the said 42 000 radiocarbon years but not much greater than that age, since otherwise the activity of the sample could not be distinguished from the background activity. Given the uncertainty in the age determination, no corrections were applied.

As it has been mentioned before, it is not clear yet whether it is valid or not to consider that all members of formation Qt_3 are of the same age. However, they probably are among the oldest pyroclastic deposits found in the Tacaná. Thus, the

episodes that originated formations Qt_1 and Qt_2 are younger than about 42 000 years. As in the case of El Chichón, some two hundred kilometers to the NW, there are no historic records of a climatic eruption but the youth of the deposits and the proximity of populated and agricultural areas around the volcano, call for a continuous monitoring of its manifestations.

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