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THE PALEOENVIRONMENTAL SEQUENCE OF THE MIRADOR BASIN IN PETÉN

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The Mirador Basin, located in northern Petén, is one of the most remote areas of the Maya Lowlands. Its intense dry season, the lack of year-round water sources, and its vast seasonal humidity, are the perfect obstacles against inhabiting there. However, the area was densely populated during the Middle and Late Preclassic periods, and scarcely occupied in the Late Classic period. The Prehispanic Maya lived in great urban centers, built massive structures, and exploited the natural resources. The evidence of such large populations has led scholars to examine the possible role that environmental changes played in the region's cultural events. The abandonment of the area, which happened at least twice, has long been a mystery for archaeologists. One possible explanation could be climatic change (Curtis et al. 1998; Hodell et al. 1995), another, environmental change caused by man through the cutting down of trees and the erosion of the soil (Binford et al. 1987: Deevery et al. 1979: Vaughan et al. 1985).

This project will attempt to provide an answer to three major research questions:

- What was the chronology of the Maya settlement in northern Petén?
- What were the environmental consequences of Maya settlement during the peak periods of population density (Late Preclassic and Late Classic)?
- Was climatic change a crucial factor for the abandonment of the area during the Late Preclassic and the Late Classic periods?

To answer these questions, sediment cores were taken from four bodies of water in the Mirador Basin: the *aguada* Zacatal, Lake Puerto Arturo, Lake Chuntuqui, and the great *sibal,* Paixban. This work presents an 8,500-year-long record of Lake Puerto Arturo, which helps to clarify our understanding of the environments during the Holocene in the Maya Lowlands. Multiple lines of research were used to recreate the vegetation and the paleoenvironment, including pollen analysis, sediment chemistry, and magnetic susceptibility.

LAKE PUERTO ARTURO

Lake Puerto Arturo (17º 32' 06" N, 90º, 11' 34" W) is shaped like a semi-circle of approximately 1.5 km^2, located 22 km northwest of the town of Carmelita (Figure 1). The lake occupies a large depression along the edge of a scarp, following an east-west orientation. The central part of the lake is dominated by emerging plants. A small island within the lake harbors ruins of structures that seem to date to the Late Classic period, although no archaeological investigation has been conducted around the lake.

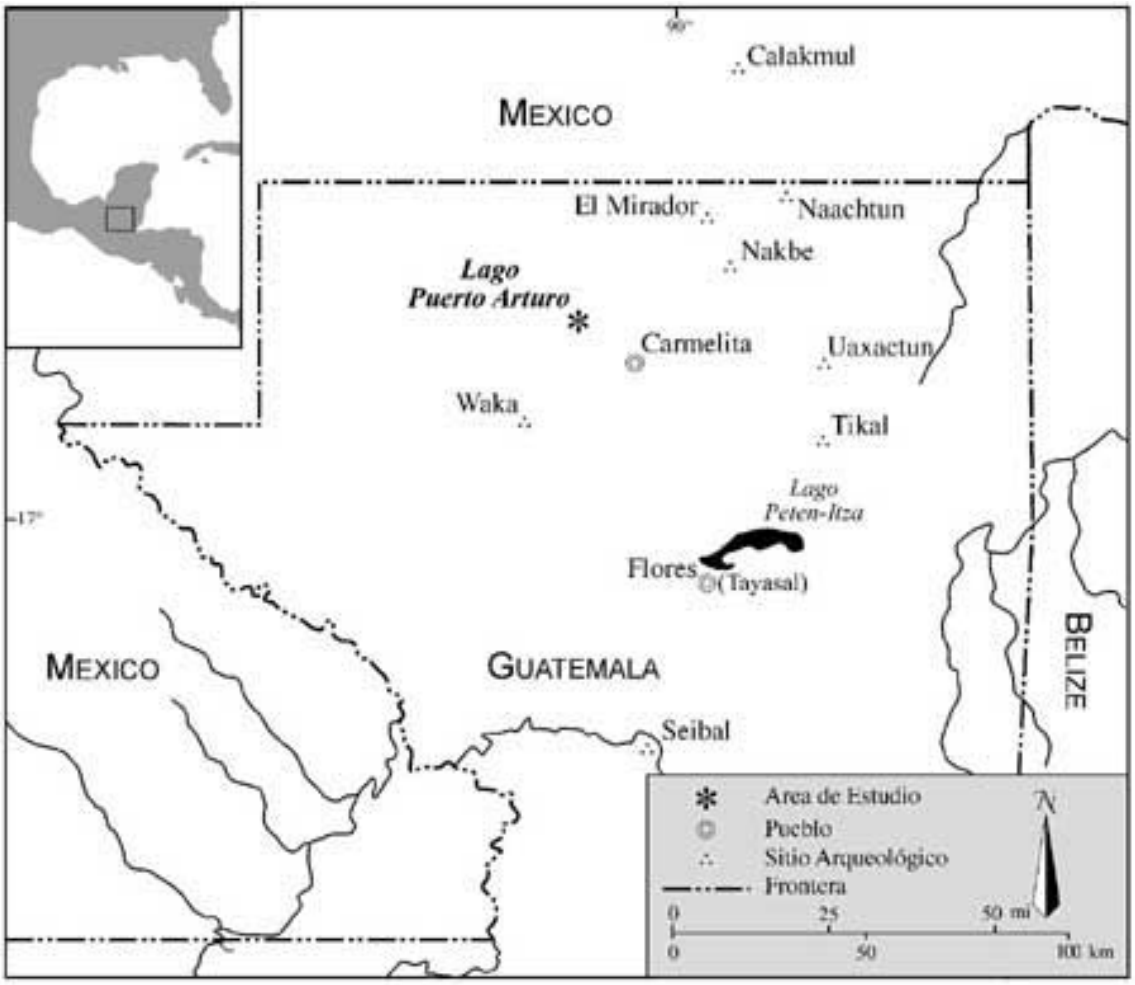

Figure 1. Location of Lake Puerto Arturo, Petén.

A sediment core was taken from the lake at some 100 m from the north bank. Cores were extracted with a Livingstone Piston Corer in an area of 7.8 m of water. A total 7.25 m of sediment were extracted. Prior to taking samples from the cores, a series of x-rays were taken. Magnetic susceptibility was tested through the use of an MS2C Bartington magnetic sensor. Pollen samples were taken to test 50 levels and were further processed using the standard procedure (Faegri and Iverson 1989). A total amount of 350 pollen grains were counted for each level.

RESULTS

The chronology is based on a series of seven AMS radiocarbon dates (Figure 2). All samples tested are terrestrial charcoal. The upper 7 m represent the entire Holocene and show a relatively stable sedimentation value. The core base dates to 7700 B.C. The radiocarbon years have been calibrated with the calendar years by means of the Calib 4.4 program (Stuiver et al. 1998). The data presented here correspond to the upper 5.75 m, because no preserved pollen was found below this level.

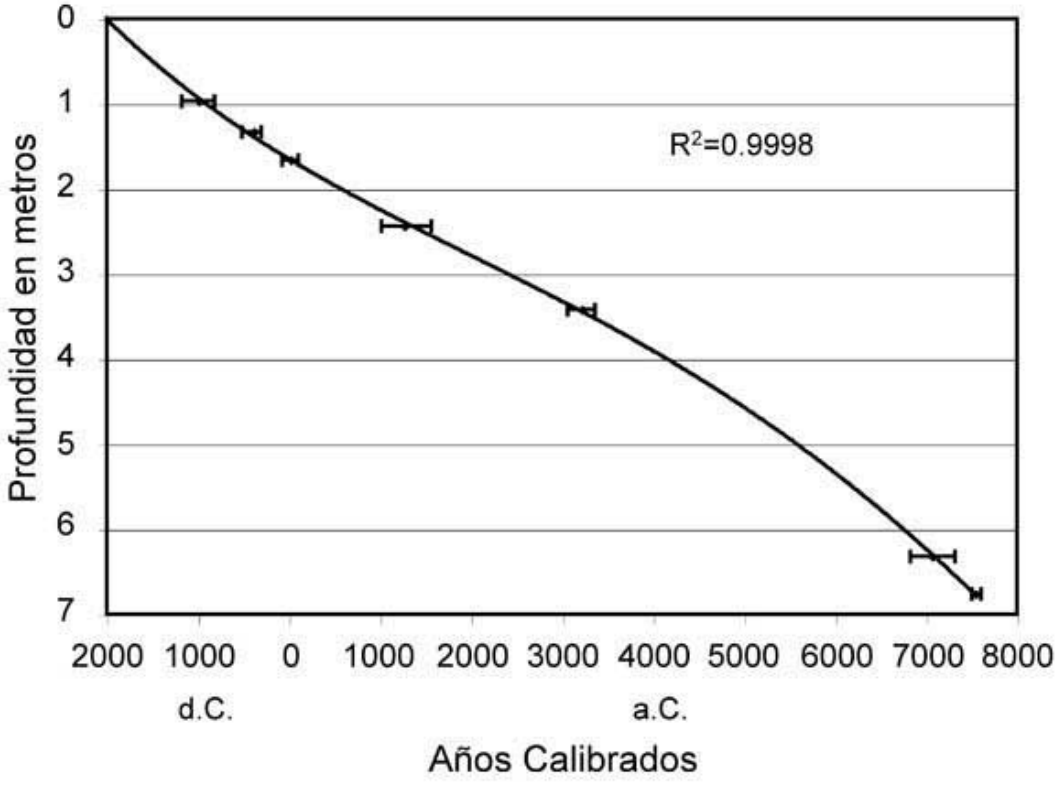

Figure 2. Referred graphic.

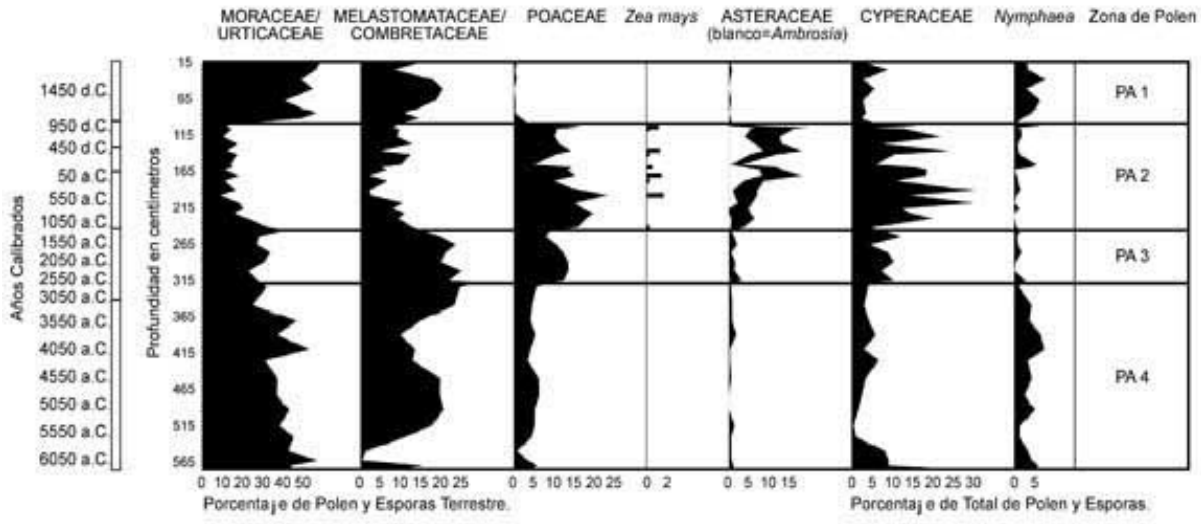

Figure 3. Referred graphic.

Figure 3 shows the record of the overall extension of pollen during the Holocene at Puerto Arturo. The vertical axis represents the core depth as well as its age. The horizontal axis shows the percentages of the amount at each profile. The *Moraceae/Urticaceae* and the *Melastomataceae/Combretaceae* families represent the rainforest. *Poaceae* and *Asteraceae* are herb families. *Ambrosia*, of the *Asteraceae* family, is an herb common to ravines. Together, the *Poaceae* and *Asteraceae* profiles suggest a disturbance in vegetation. *Cyperaceae* belong to the family of sedges, and *Nymphaea* is an aquatic plant known under the name of *Naab* in Petén. For the purpose of this discussion, the diagram has been divided in four zones.

ZONE 4: 6500-2700 B.C.

The high percentages of pollen from the *Moraceae/Urticaceae* and *M/C* families show that the vegetation of the Early to Middle Holocene age at the Mirador Basin was predominantly rainforest of the lowlands. The pollen of these groups is found in high percentages in the lower levels of the pollen record, which shows that the forest was established very early in the Holocene.

ZONE 3: 2700-1450 B.C.

The changing pollen frequencies at the beginning of Zone 3 reflect the beginning of the settlements and a consistent increase in the indicators of agrarian modification. The percentages corresponding to *Poaceae* and *Asteraceae* increase abruptly. The percentages of the forest taxa start an extended and constant decline.

Zone 2: 1450 B.C. - A.D. 950

Zone 2 reflects the period of Maya settlement in the Lowlands since the Middle Preclassic period and up to the Late Classic period. This is an important period of anthropogenic impact. Around 1450 B.C., the record shows an intense deforestation and a remarkable second increase in the indicators of agrarian modification. *Zea* pollen is only found in this zone.

The temporary, remarkable decrease of disturbance indicators around 1.55 m is of particular interest in this zone. The percentages of *Poaceae, Asteraceae* and *Ambrosia* descend to values previous to the settlement. The dating of these changes, around AD 150, is consistent with the abandonment occurred during the Late Preclassic period, shown in the archaeological record.

ZONE 1: A.D. 950 – TO THE PRESENT

The transition at 1 m in the pollen spectrum, which records a change in the disturbance indicators of the forest, reflects the abandonment that occurred during the Late Classic period. Disturbance indicators reach important values at 1.03 m, around AD 890. The next level tested, at 1 m, or AD 960, shows a dramatic decrease in disturbance indicators.

After producing this Holocene record, a closer look at the zone associated with the settlement seems to be necessary. A series of 30 additional levels were analyzed starting from Zone 2, to increase the resolution of this important period of time. Also, every *Zea* pollen level was recorded, to determine precisely the moment of its initial appearance in the record.

This extended pollen analysis has provided some interesting results (Figure 4). The stars mark the levels with *Zea* pollen found during the records of low increase. *Zea* is present early in this core; corresponding to approximately 2700 B.C., it represents the earliest one found within the Yucatan Peninsula. It first appeared in coincidence with an initial increase observed in the modification markers, and is followed by a decrease in the taxonomic entities of the forest. The presence of *Zea* pollen at such an early date is not unexpected; the extension of the Holocene records from other lakes at Petén shows an initial decrease in the forest's taxa at that time (Islebe et al. 1996; Leyden 2002). There is no *Zea* pollen in these records, but it is present in the earlier ones, around 1000 B.C., and its previous absence has posed the question of whether it was the desiccation occurred in the Middle Holocene or the settlement and agriculture, that caused the decrease of the forest's taxa. Their presence at Puerto Arturo around 2700 B.C. strongly points to the fact that the changing pollen frequency during the Middle Holocene in other lakes of Petén indicates the impact caused by sedentary agriculture.

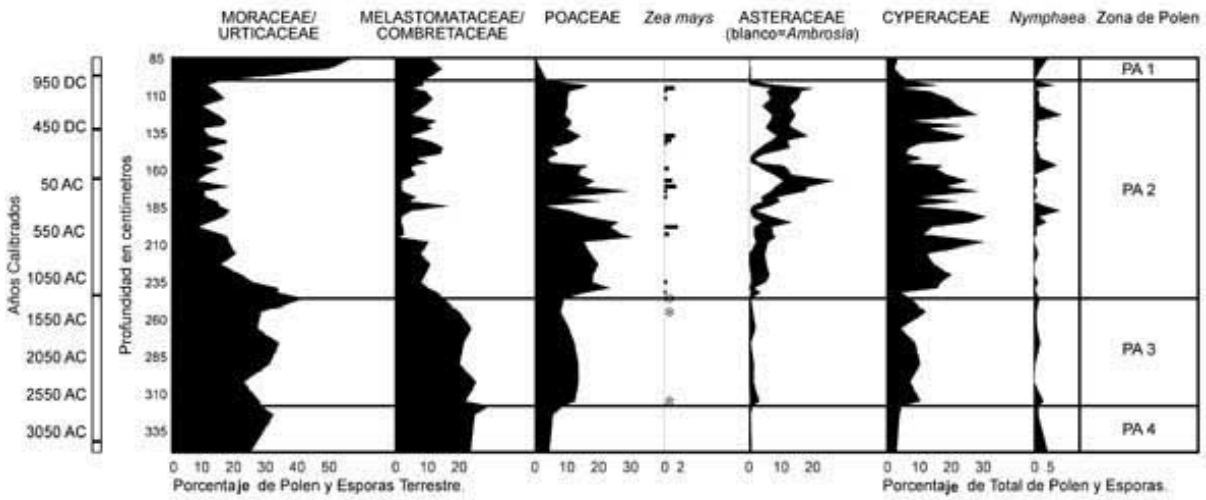

Figure 4. Referred graphic.

Figure 4 shows clear evidence of abandonment of the Mirador Basin, which occurred during the Preclassic period. All markers of vegetation disturbance decrease dramatically, and remain low throughout numerous levels centered close to

165 B.C. In fact, an earlier abandonment was revealed during this study. Here we have found a similar decrease in disturbance, centered around 400 B.C.

The curve of magnetic susceptibility represents penetration of mineral in the sediment matrix, and is used to produce a record of the erosion (Verosub and Roberts 1995). The magnetic curve shows a correlation with the pollen record. The peaks in the magnetic signal are level with the peaks in the pollen record (Figure 5). Likewise, the periods of abandonment evidenced by pollen profiles are shown in the form of periods with lower magnetic values. The higher values for herbs, *Zea*, and erosion are present in the Preclassic period, supporting the archaeological evidence of dense populations. Although there is evidence of continued disturbance during the Classic period, the erosion in the lake basin was much less significant during that time, with a brief increase during the Late Classic period.

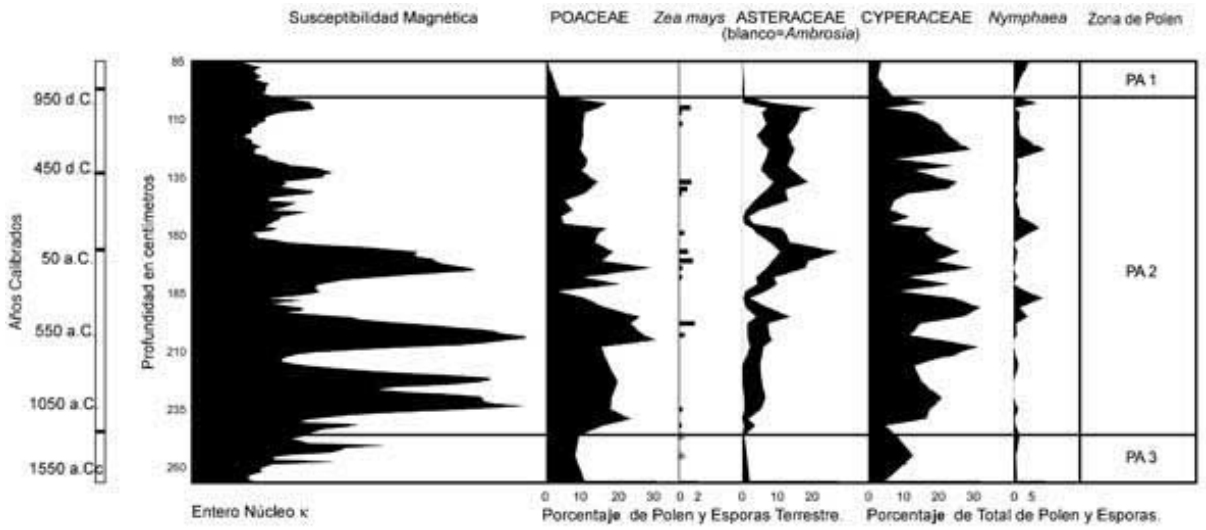

Figure 5. Referred graphic.

This record of Puerto Arturo shows strong paleoecological evidence of the abandonment occurred during the Preclassic period in the Mirador Basin. Moreover, it shows that long before (around 400 B.C.) there was a dramatic decrease of agricultural modification in the basin.

FUTURE INVESTIGATION

The project is currently in the process of combining samples to produce a climate record for Puerto Arturo. Right now, tests of stable isotopes, charcoal, and geo-chemical samples are being conducted on the core from Puerto Arturo.

We also initiated analysis of a sediment core recovered at Paixban, a large *sibal* located within the Mirador Basin. This core presents an 8,000-year-long record and apparently shows major environmental change.

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Figure 1 Location of Lake Puerto Arturo, Petén
Figure 2 Referred graphic
Figure 3 Referred graphic
Figure 4 Referred graphic
Figure 5 Referred graphic