Paleobotanical Research at Copán, Honduras

Research Year: 2002
Culture: Maya
Chronology: Pre-Classic and Classic
Location: Copán, Honduras
Sites: El Paraíso, Petapilla, and Las Sierras

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Abstract

A grant from the Foundation for the Advancement of Mesoamerican Studies, Inc., (FAMSI), was used to fund Accelerator Mass Spectrometry dating of sediment cores recovered from three bodies of water in the Copán Valley and the adjoining area of El Paraíso, and for comparative analysis of a tephra layer recovered from one of the sediment cores. Sediment cores from two of these bodies of water, Petapilla and Las Sierras, contain pollen records covering the Preclassic and Classic periods. Sediment from the base of a third core extracted from a laguna near El Paraíso had a modern date.

Resumen

Los fondos de FAMSI fueron utilizados para fechar mediante la espectrometría por aceleración de masas, (*Accelerator Mass Spectrometry, AMS*) las columnas de sedimento obtenidas de tres superficies de agua en la red de drenaje de Copán, y para el análisis comparativo de una capa de tefra obtenida de una de las columnas de sedimento. Las columnas de sedimento obtenidas de las dos superficies de agua, Petapilla y Las Sierras, contienen registros de polen que abarcan los períodos Preclásico y Clásicos. Los sedimentos provenientes de la base de una tercera columna extraída de una laguna cerca de El Paraíso dieron como resultado una fecha moderna.

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Goals of Paleobotanical Research in Copán

Research focusing on the collection and analysis of sediment cores from the Copán Valley was begun in 2001. The primary goal of this project was the recovery of at least one sediment core that would span the Preclassic and Early Classic Periods. Information on the ecological setting of the valley at the time of Maya arrival was sought to define the environmental context of constructions uncovered by the Early Copán Acropolis Program (ECAP) of the University of Pennsylvania Museum, directed by Robert Sharer. Despite attempts by earlier projects, a sediment core extending

throughout the Classic and containing well-preserved pollen had not been previously recovered at Copán.

In 2001, sediment cores were extracted from six bodies of water. A section of sediment from a core extracted from the Petapilla bog was submitted to Beta Analytic and found to have a date of Cal B.C. 900-790 (All radiocarbon dates are reported as the 2 sigma calibrated range, using INTCAL 98 [Stuiver and van der Plicht 1998]). A grant was sought to cover further dating of the Petapilla sediment core and two others. FAMSI later approved the use of funds for analysis of a volcanic ash layer found in the Petapilla sediment core.

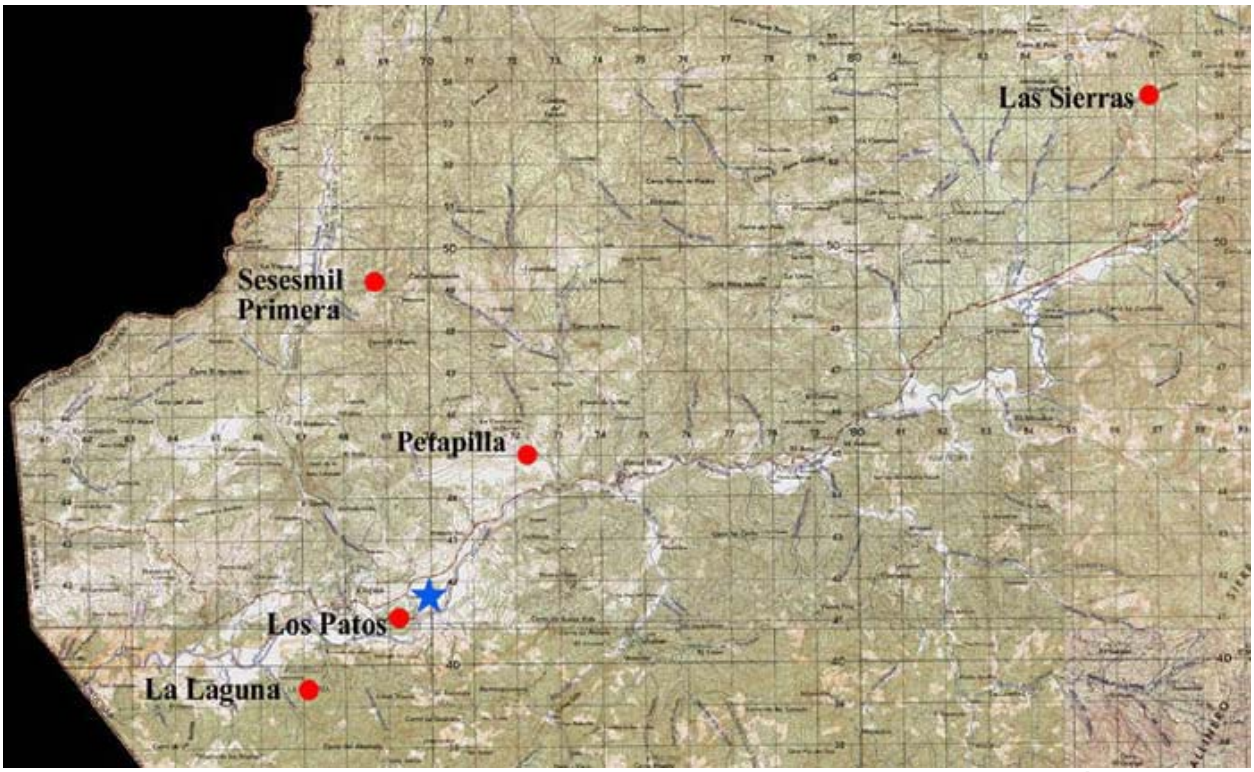

Figure 1. Location of five bodies of water cored for sediment samples in the Copán Valley.

Sediment Core Extraction

Sediment cores were extracted from five bodies of water in the Copán Valley (La Laguna de Petapilla, La Laguna de Las Sierras, La Laguna de Sesesmil Primera, La Laguna de La Laguna de Copán and from a largely filled-in laguna to the southwest of the Acropolis, referred to as La Laguna de Los Patos) (Figure 1), and from one body of water in the adjoining area of El Paraíso (La Laguna de La Laguna cerca del Paraíso).

FAMSI funds were used for AMS dating of sediment from three of these lagunas: Petapilla, Las Sierras, and La Laguna near El Paraíso.

Figure 2. Coring in La Laguna de Sesesmil with assistance from Rigoberto Morales and Obdulio Garza.

Methodology

Extraction of sediment cores from lagunas

The sediment cores discussed in this report were extracted using a Livingstone Sampler with a Vohnout locking piston and sampling tubes of 1.5 inches in diameter (for further information, see Colinvaux *et al*. 1999). A platform was constructed at each of the lagunas except Los Patos (which is only a marsh-like depression) to allow coring of the deepest sections of the lagunas (Figure 2). The platform consisted of two small inflatable boats with five bamboo poles laid perpendicular across them and then four pine planks laid parallel to the boats–two over each boat. A small metal frame (12x12 inches) was placed on the laguna bottom to act as a guide when reinserting the Livingstone sampler (Figure 3).

Figure 3. Coring table.

Analysis of fossil pollen samples

Pollen samples are being analyzed by Cameron McNeil in the paleoecology laboratory of David Burney at Fordham University. The procedure used to extract the pollen from the sediment samples is based on the pollen processing procedure as set forth in Faegri *et al*. (1989). To begin the process of analysis, a half cubic centimeter of soil is placed in a 15 millimeter test tube. The samples are first exposed to 10% HCl, before the test tubes are placed in boiling water for two minutes and then centrifuged and decanted. Then the samples are rinsed twice with water. Following this, 5% KOH is squirted into the test tubes and then the tubes are boiled for 8-10 minutes. Then the samples are centrifuged and decanted and rinsed twice in water. Following this, 5% sodium pyrophosphate is placed in the tubes and the tubes are boiled for 20 minutes. Samples are then poured through screens to remove rock fragments and large pieces of charcoal and other debris. The samples are then twice rinsed in distilled water, which is centrifuged and decanted from the samples. Forty-nine percent HF is then added to the samples, which are left to soak for 24 hours. Following this, they are boiled for 45 minutes to dissolve silicates contained in the sample. This process is repeated a second time. When this process is finished, the samples are centrifuged and decanted and then rinsed with 10% HCl three times. They are then rinsed with water, twice. Following this,

the samples are rinsed with glacial acetic acid and then centrifuged and decanted. An acetolysis mixture is then prepared from acetic anhydride and sulfuric acid. This acid mixture is added to the samples and the samples are boiled for four minutes and then centrifuged and decanted. Then they are rinsed with glacial acetic acid, centrifuged and decanted and rinsed twice with water. Following this, KOH is placed in the test tubes a second time and the tubes are placed in boiling water for five minutes. Then the samples are rinsed twice with water, a spike is added and the sample is rinsed three more times with water. Five percent HCl is added to break down the spike and the samples are then rinsed with water three more times. Fifty percent glycerine is then added to the test tubes. The sample is centrifuged one last time and all excess glycerine is poured out. The test tubes are then placed in a vacuum oven to remove all excess water from the samples. Three slides are then made from each of the test tubes.

Slides are analyzed with the use of an extensive pollen comparative collection and reference books housed in the laboratory. The standard of statistical significance used in the analysis is the presence of at least 200 arboreal pollen grains per sample.

Preliminary Results

La Laguna de Petapilla

Location: N 14 degrees 52.154', W089 degrees 06.979'

Altitude: 2415 feet

Sediment core extracted with a Livingstone Sampler

Dates submitted for AMS dating under this grant: Five

1. Cal A.D. 1220-1300
2. Cal A.D. 780-980
3. Cal A.D. 420-620
4. Cal B.C. 10-A.D. 140
5. Cal B.C. 380-160

Sediment cores have been extracted from the Petapilla bog three times in the past by two projects, first by William Turner and William Johnson of the PAC I project, and then twice by David Rue of Pennsylvania State University, for PAC II (Turner *et al*. 1983; Rue 1987; Webster *et al*. 1996). Of these three cores, the last one, extracted by David Rue contained the oldest basal sediments, with a calibrated date of 3637 B.C. (4821 ± 67 BP) on the lowest dated sediments (Rue, Webster, and Traverse 2002). Unfortunately, Rue found poor pollen preservation in this sediment core and thus, primarily pursued only microscopic charcoal analysis (2002).

Figure 4. La Laguna de Petapilla. Petapilla is doughnut-shaped with an island of trees in the center.

Three cores were extracted from Petapilla in the Spring and early Summer of 2001. The first of these (taken in the eastern section of the bog), did not penetrate deep enough into the sediments and will not be analyzed. The second core (Petapilla 1), extracted in the southern section, near the area where Rue extracted his later core, broke in the fifth meter, possibly as a product of a tephra layer, which created a weak section in the core. The third core, referred to as Petapilla 2, was extracted from the western section of the laguna and is intact in all but its first meter. The piston struck a rock in the first meter, which obstructed the tube and prevented the intake of approximately 50 centimeters of sediment.

Analysis of the sediments from Petapilla 2 is ongoing. The overall preservation of pollen in the core is good, however statistical significance could not be achieved in some mid-Preclassic levels. FAMSI funds were used to date five sediment samples from this core. All dates have been sequential, thus far. The earliest sediments of the core date to 900-790 cal yr B.C.

Significant preliminary results of this analysis consist of the existence of two clear deforestation episodes (one in the Early Preclassic and one during the Early Classic), the presence of the Tierra Blanca Joven (TBJ) tephra layer from Volcan Ilopango in El Salvador, and a possible re-dating of the reforestation of the area near the Acropolis at the end of the Classic period. Not surprisingly, pollen of *Zea mays i*s present in the core from its earliest levels.

The first deforestation episode in the valley during the last three thousand years was in progress by the Early Preclassic, which is found in the lowest levels of Petapilla 2. This episode lasted for approximately 200 years. The early human inhabitants of the valley undoubtedly set the ecological stage for the later Early Classic Maya interlopers. The ecological impact of the Preclassic population may have been more significant than previously thought. The second deforestation episode began during the Protoclassic, as defined by Fash (2001).

While it is clear from the analysis that there are periods of intermittent reforestation between the Early Preclassic and Classic Periods, no reforestation episodes in Copán are as dramatic as the one following the Classic. A peat sample submitted to Beta Analytic, from below, and thus, slightly older than the last peak in upland herbs, has a date of A.D. 780-980. A second date is required to bracket this date and thus achieve a secure date for the reforestation of the valley following the political collapse of the Copán polity. These results are substantially different from previous work conducted by David Rue, which placed the reforestation of the valley around A.D. 1250 (Webster *et al*. 2000), and more analysis will be conducted to test them (i.e. completion of pollen counts to statistical significance, microscopic charcoal analysis, and the submission of a second date that brackets the reforestation of the area around the Acropolis). One explanation for the difference in the results may be the enlarged frame of reference: changes in the vegetation percentages found by Rue in his analysis of Petapilla may appear less significant when compared with a longer vegetation history.

Tierra Blanca Joven

The first remnant of the important Tierra Blanca Joven eruption to be found in Copán is in the Petapilla 2 sediment core and consists of a solid white layer approximately 321.75 centimeters below the sediment surface.

When examined under a microscope, the TBJ layer is composed of shards of volcanic glass with little organic content. A section of this tephra layer was sent to Andrei Sarna-Wojcicki of the United States Geological Survey. Sarna-Wojcicki compared the chemical signature of the tephra with a reference sample of TBJ from Laguneta El Trapiche in El Salvador, which was supplied by Robert Dull, and determined that the Petapilla tephra was from the same Ilopango eruption.

Scholars have pondered the effect of the TBJ eruption on southern Mesoamerica (Sheets 1987; Dull *et al*. 2001). Hopefully this layer will provide an enlarged understanding of TBJ's impact on the inhabitants of the Copán Valley.

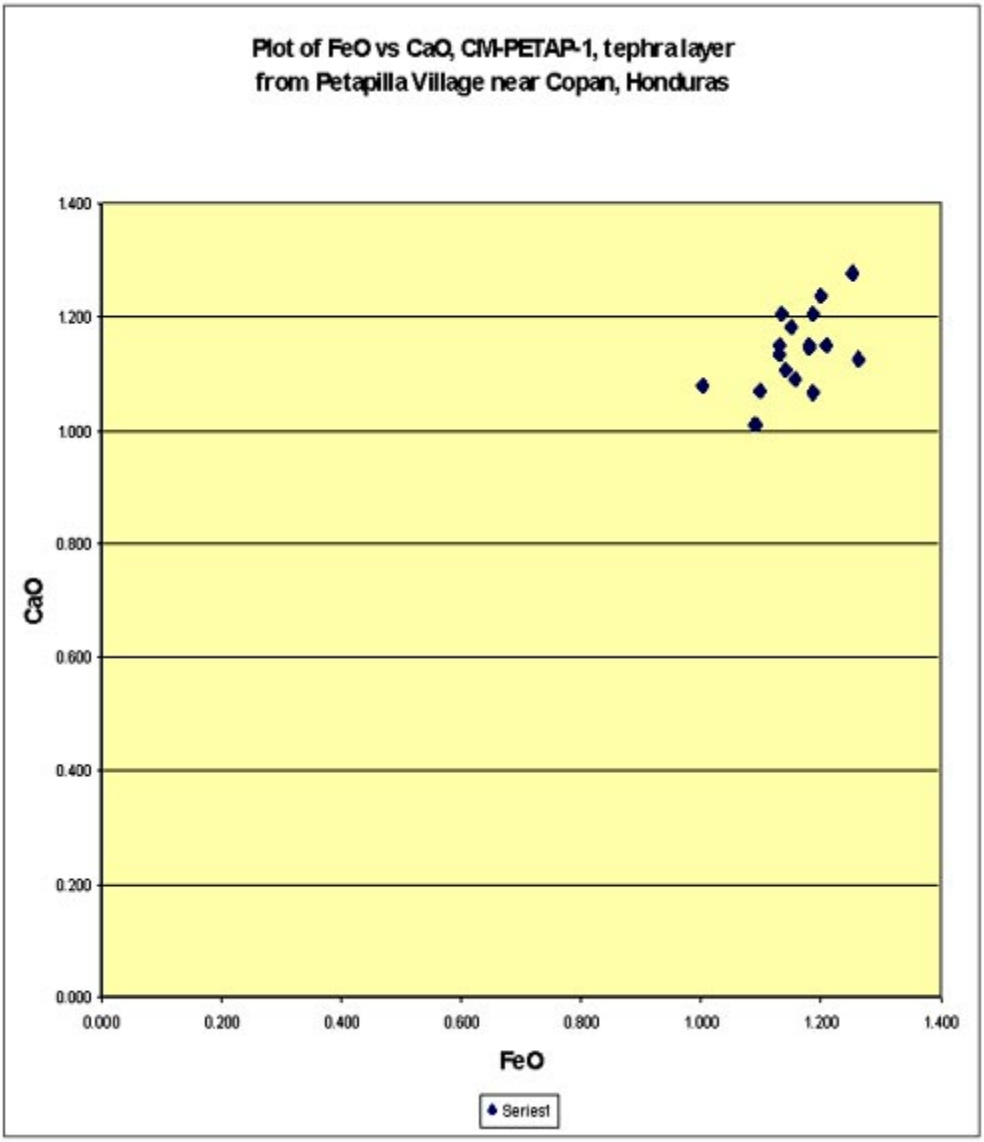

Figure 5a. Plot of FeO vs CaO, CM-PETAP-1, tephra layer from Petapilla Village near Copán, Honduras.

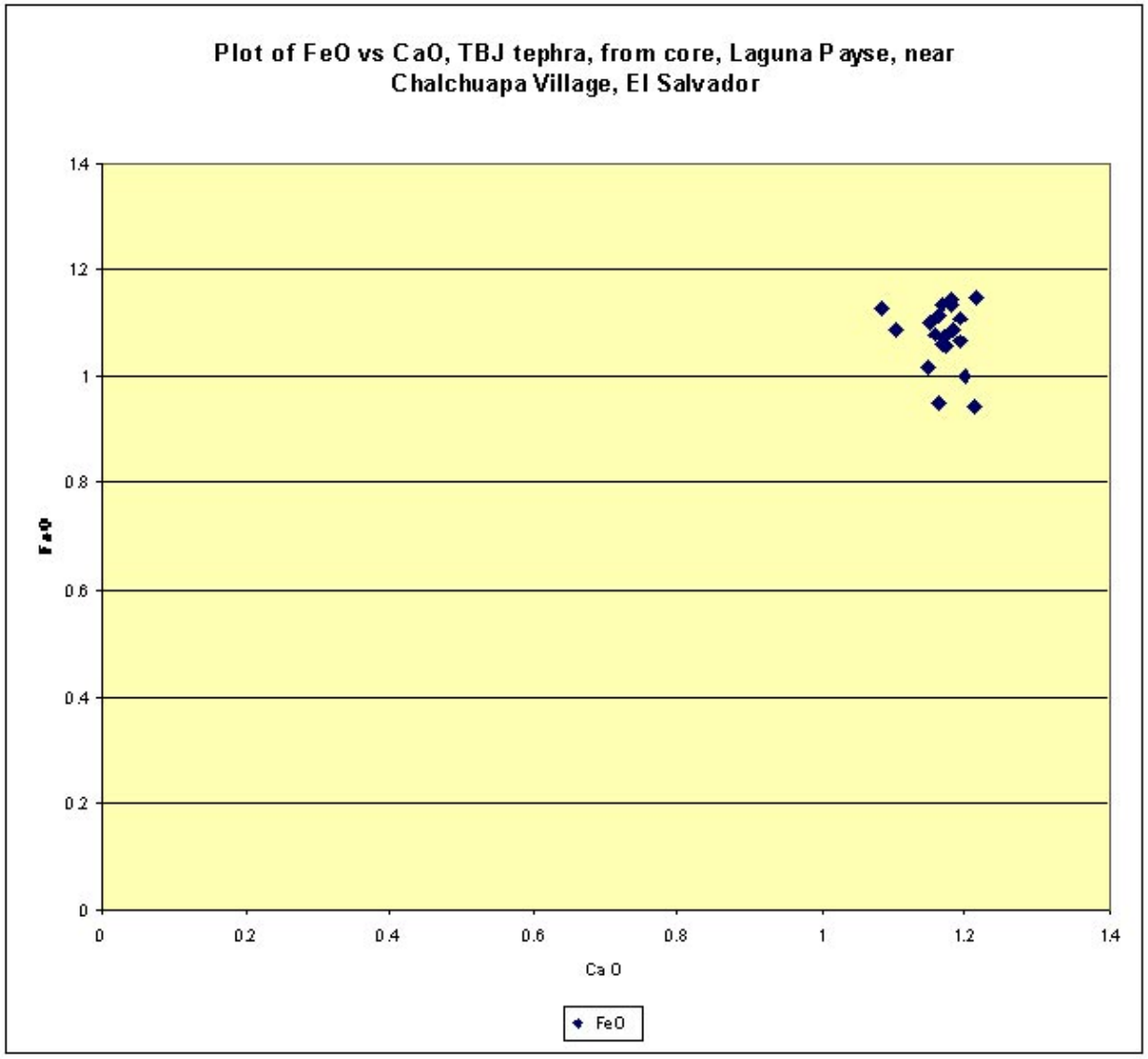

Figure 5b. Plot of FeO vs CaO, TBJ tephra, from core, Laguna Payse, near Chalchuapa Village, El Salvador.

Pond in the village of Las Sierras

Location: N 14 degrees 57.004', W 088 degrees 58.749'

Altitude: 3371 feet

Track 358 degrees

Cored with a Livingstone Sampler

Basal date of core is Cal B.C. 7500-7300

Dates submitted for AMS dating under this grant: Three

1. Cal A.D. 1160-1280
2. Cal B.C. 2590-2450
3. Cal B.C. 7500-7300

The pond in the village of Las Sierras preserves nearly 10,000 years of sediment with a basal date of 7500-7300 cal yr B.C. This body of water is fed by at least two natural springs. The long sediment history would imply that these springs prevented the pond from drying up during periods of drought. Unfortunately, the earliest levels of the sediments are dominated by fern spores and contain few, if any, pollen grains. Nonetheless, it is unlikely that older pollen-bearing sediments will be recovered from elsewhere in the Valley (as few, if any, unsampled natural bodies of water remain). The pollen diversity and amount of pollen present in the majority of sediments from this core is excellent, although the preservation is sometimes poor. It is clear from preliminary analysis of the core that the sedimentation rate in this body of water was remarkably slow, and thus, although it is a short core at 160.5 centimeters, it contains a long record of environmental conditions in the Valley.

Figure 6. Pond of Las Sierras. Photo courtesy of Juan Carlos Rodríguez.

Results on three AMS dates have been received on macrofossils and sediments from this core. In addition to the one mentioned above, leaf and bark fragments eighty-eight centimeters below the sediment surface of the core produced a date of 2590-2450 cal yr B.C. and a date on sediments forty-five centimeters below the sediment surface were dated to 1160-1280 cal yr A.D. Admittedly the resolution in this core is poor with each centimeter potentially representing nearly 60 years of vegetation history. However, the record contained in this pond will be invaluable for understanding conditions in the valley prior to human arrival and the date of that arrival and may help clarify issues surrounding the Maya collapse at Copán when compared with information from the Petapilla sediment core.

Pond near La Laguna outside of El Paraíso

Location: N 15 degrees 04.657', W 088 degrees 56.390'

Altitude: 2630 feet

Cored with a Livingstone Sampler

Two sediment cores were extracted

Basal date of core is modern

Dates submitted for AMS dating under this grant: One

1. Modern

Two sediment cores were extracted from this large pond. Local people said that Hurricane Mitch moved a large section of the pond downstream when water rushed through the ravine which leads to this body of water. It was not possible to extract more than 2.5 meters of sediment in either of the cored areas of the pond. A sample of the lowest sediments from El Paraíso 1, was submitted for an AMS date to Beta Analytic. The sediments registered a modern date. Unfortunately, the sediments in this large body of water were clearly highly disturbed by Hurricane Mitch (and possibly by earlier hurricanes) and will not be useful for the study of long term environmental conditions in the El Paraíso Valley or the Copán drainage network.

Figure 7. The Laguna of the community of La Laguna near El Paraíso, Honduras.

Conclusions

Through careful analysis of pollen from sediment cores, a wealth of new information on plant use and Pre-Columbian environmental exploitation at Copán is emerging. In the near future, analysis of the sediment cores will produce detailed environmental records from at least two areas of the Copán Valley. These sediment cores will increase our understanding of the impact of human arrival, occupation, and virtual abandonment on the valley.

Acknowledgments

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Tulio Cantillano, Jorge H. Ramos, Timothy W. Pugh, Fredy Rodríguez, Juan Carlos Rodríguez, Carolina Sandoval, William Loker, and Allan Maca.

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