

# Wright, David R.

## Soil Resources of the Ancient Maya in the Petexbatún Region of Guatemala, Delineated by Soil Properties and Stable Isotopes

Faculty Mentor: Richard E. Terry, Plant and Animal Sciences



The Maya culture of Mesoamerica has always been shrouded in mystery, much of which surrounds its tremendous rise and (yet) unexplained fall. The Maya managed to sustain enormous populations in an environmentally fragile setting. Like all cultures throughout history, the Maya culture prospered from the soils beneath it. Despite extensive excavation and investigation of Maya sites, relatively little is understood of the agricultural methods that led to such successful subsistence. Understanding is deficient because cultivated areas tend to leave few visible remains besides an occasional terrace or canal, and also because traditionally most investigative efforts have focused on elite structures and artifacts. Recently, though, interest in ancient agriculture has increased, and soil science is being applied to archaeology in ways that may remove the shroud of mystery.

In June 2003, our team of BYU researchers collected samples from the area surrounding Aguateca, an archaeological site in the Petexbatún region of Guatemala. This Classic Maya site, featured in the February 1993 and May 2003 issues of *National Geographic*, served as a capital and is famous for its location atop an escarpment that acted as a natural fortress. It was conquered and rapidly abandoned c. 800 A.D. The soils of the area evolve from karst topography, and although they are quite fertile, they are also easily eroded.

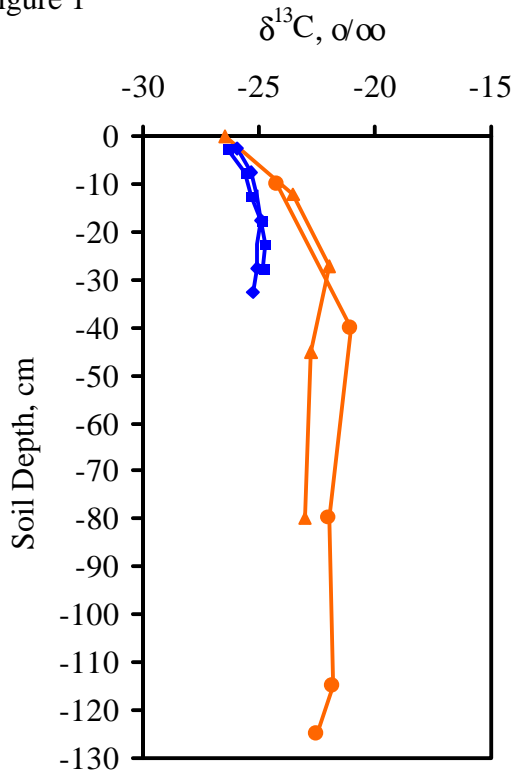
Soil samples were collected from varying depths around Aguateca and field data were gathered and compared to archaeological notes. The profiles were also classified according to USDA classification standards. In the BYU Soils Laboratory, the samples were dried, ground and acidified. Stable carbon isotope ratios (as explained below) were determined on a mass spectrometer coupled with an elemental analyzer and then graphed. Our aim was to describe and analyze soils from various landscapes around the site in order to identify areas that were cultivated anciently.

Even in the absence of structural or artifactual evidence, the delineation of ancient agricultural areas is possible because several clues are retained in the soil. The primary line of evidence investigated in this study was the carbon isotopic signature of the soil. Among all crops cultivated by the Maya, maize was of utmost importance. Fortunately, past cultivation of maize can be detected because maize possesses the C4 photosynthetic pathway while most other plant species of the forest environment are C3. Because C4 plants are less discriminatory toward the heavier carbon isotope,  $^{13}\text{C}$ , the plant material becomes enriched in it. When the plant material breaks down to form soil organic matter, this isotopic fractionation is preserved. Therefore, where forest was cleared, maize was cultivated, and the forest canopy once again closed, a tell tale pattern of  $\delta^{13}\text{C}$ -enrichment will be evident in the soil organic matter at depth.

Two features around Aguateca were studied: a set of contour terraces to the southwest of the site and several *rejolladas*, or natural sinkhole depressions, to the northeast. The terraces consist of six low retaining walls of loosely stacked pieces of bedrock constructed on a 6% slope. The terraces are not well constructed and are most likely a modification of a natural feature. They were obvious candidates for our agricultural investigation. The *rejolladas* were also probably cultivated, as the soils are fertile and very thick. The *rejolladas* lack any man-made structures and range from 75-200m in diameter and 5-15m deep and are located close to the site center.

Isotopic evidence was not found that maize was cultivated on the terraces. The graphs of the terrace soil profiles (blue lines, Figure 1) show no significant (>4‰) enrichment of  $\delta^{13}\text{C}$  within the soil profile. Therefore, because the characteristic C4 signature is absent in the soil humus, it is unlikely that maize was cultivated on these terraces, but they may have been used for the cultivation of some other crop. Beans and squash, which are both C3 plants, were also grown by

Figure 1



the Maya and would leave a  $\delta^{13}\text{C}$  signature similar to those observed in the terrace profile samples. Granted, the soils retained by the terraces are relatively shallow and would have been only 15-20 cm deep 1000 years ago. While this shallow depth of soil may seem inconsequential, it may have been very valuable if other soils of the area were more severely eroded (erosion has long been hypothesized as a contributing factor to the downfall of the Maya).

If the terraces were not used for the cultivation of maize, it becomes even more likely that the *rejolladas* were. The *rejolladas* occupy a large portion of the landscape directly around the site center, and would have retained soil susceptible to erosion as environmental strain increased. They also would have retained moisture during the dry season, and both elements would have been valuable. Our speculation is supported by the  $\delta^{13}\text{C}$  values of the *rejollada* profile samples (red lines, Figure 1), which generally show  $\delta^{13}\text{C}$  enrichment typical of long-term maize cultivation. A return shift to values typical of C3 plants is evident in the upper 20-30 cm of the profile, equivalent to ~1200 years of soil formation

after the abandonment of the site. While these  $\delta^{13}\text{C}$  values are typical of all C4 vegetation and not specifically maize, only maize was valuable enough to justify the labor input necessary to keep the forest at bay. The prominent shift evident in the *rejollada* graphs and absent in control samples (and the terrace profiles) suggests that the *rejolladas* were used for long-term maize cultivation and were a valuable, sustainable agricultural asset. While further work must be done to fully interpret the many facets of agriculture in Aguateca and the region, our study marks a starting point: as we define the function of a few key features of the landscape, we gain a more holistic view of the complex environment in which the Maya culture rose and fell.<sup>i</sup>

<sup>i</sup> The author gratefully acknowledges the help received from Dr. Richard Terry, Kris Johnson, Dr. Markus Eberl, and others.