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The 2004 Vaca Pateau Geoarcheology Expedition - Belize

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Available at: https://works.bepress.com/lee_florea/17/
THE VACA PLATEAU GEOARCHAEOLOGICAL PROJECT

The Maya center of Ix Chel lies twenty kilometers into the jungle of Belize. It seems to be undisturbed by people except for the occasional gang crossing the nearby Guatemalan border. Their passage is marked only by lean-tos constructed of wood and palm fronds, and voices that carry through the jungle, speaking in Spanish. And except for looters' trenches carved into the angular, tree-topped pyramids that have been eroded by time, there is little evidence of any human contact since the abandonment of this Maya site over a thousand years ago.

A road does lead past a long-abandoned logging camp called Spanish Waterhole to within 200 feet of Ix Chel, but it is overgrown and muddy, perhaps impassable to almost all four-wheeled vehicles except for the farm tractor that stutters its way through the trees behind us, pulling a trailer with our gear, food, and water upon it. We're walking ahead of the tractor, cutting large branches out of the way with machetes. There are ten of us, not counting the farmer upon his tractor and his two sons, one of whom carries a rifle on his shoulder, a bit more unsteadily than we'd like. A Belizean whom we know only as "Dred," with moldering dreadlocks and an omnipresent odor of marijuana, cranks a chainsaw to life and slices at a tree lying across the road. An hour later, an axe falls from the trailer and pops a tire, leaving nothing but a rim on the right-hand side of the trailer. With no spare tire, the farmer pushes the tractor on, the trailer with our equipment and supplies skidding and sidewinding through the mud behind him.

We're in Belize for the fifteenth field season of the Vaca Plateau Geoarchaeological Project (VPGP). The VPGP is the longest continuous geoarchaeology project operating in Belize and has substantially expanded the existing base of knowledge regarding relationships between the Maya physical and cultural landscapes in this remote section of Mesoamerica.

Our eight-day expedition to the study area in May of 2004 launches the newest phase of this project, focusing on (1) continued mapping of caves and surface ruins, (2) collection of soil from caves and speleothems to determine long-term trends in paleoclimate and paleovegetation, and (3) geologic mapping.

THE VACA PLATEAU

Our camp is located in a gap along the drainage divide between the Macal and Chiquibul Rivers, and is nestled in the shadow of ancient Ix Chel. We pitch our tents in a rainstorm on two ancient agricultural terraces. Once cleared of leaves and debris (so that we wouldn't stumble over snakes in camp), the terraced levels of our camp becomes a comfortable base of operations, with plastic drop cloths strung from tree to tree as a sort of breezeway, and plastic lawn chairs that the crew has stashed in a nearby cave from the previous year.

It soon becomes evident that the Maya have left precious little of this landscape unaltered. The central pyramids of Ix Chel are less than 200 meters away. To the untrained eye, these structures appear as strangely rectangular hills, some with deep gouges in their flanks. With more than 40 mapped structures,
the Ix Chel site represents a large Mayan center, vastly unstudied due to its remote location. At the edge of camp and at the base of the central pyramid of Ix Chel is the Macal Chasm, a massive pit cave with a 53-meter-deep entrance shaft. We didn’t drop into the pit on this trip, but we know that there are human skeletal remains in the debris cone, suggesting that it served as a sacrificial site for the inhabitants of Ix Chel.

Ix Chel is the heart of the VPGP field site, a 25 km² section of the Vaca Plateau in West-Central Belize (Reeder et al. 1996, 2003; Webster et al. 2000). The VPGP combines archaeology with various aspects of the geosciences to investigate both the physical and cultural landscapes of the area. Philip Reeder, an Associate Professor of Geography at the University of South Florida, has directed the project since its inception in 1990, and along with other researchers, has fielded research expeditions to the study area for the last 15 years. The Vaca Plateau is a distinct geomorphic province in the Cayo District, Belize and consists of the rugged topography between the Maya Mountains and the Macal River to the east, the Chiquibul River to the west in Guatemala, the border town of Benque Viejo to the north, and the Caracol archaeological site to the south. The northern and southern limits of the plateau appear to be defined by east-northeast striking faults (Reeder et al. 1996). Typical topographic relief is approximately 100 meters. The landscape is highly karstified with an integrated system of dry valleys, residual hills, cockpits, and compound sinkholes.

Water is noticeably absent at the surface of the Vaca Plateau. This has posed problems for both past habitation and present exploration. The Maya modified the physical landscape by building terraces and catchments whose remains are visible everywhere in the study area. The only potential source of nearby water is a small Maya catchment that still holds water after ten centuries of disuse. This water hole is fouled by a group of howler monkeys. We hear them nightly, making their way down to the water hole. Sound travels so strangely among the trees that they seem to be in the branches above us, their otherworldly screams echoing back and forth across the valleys like the cries of banshees. For our trip, we must haul all potable water into the jungle with us.

Members of the VPGP have located, explored, and mapped more than 150 caves on the plateau during the past 15 years (Webster and Reeder, 2000). None of the caves are extensive like those along the flanks of the Maya Mountains to the east or those in the headwaters of the Chiquibul River south of Caracol. We suspect that the large, non-karstified, external drainage basins for those sites (lacking on the Vaca Plateau) provide the driving force necessary to develop lengthy river systems. The caves in the study area tend to be vertical and require knowledge of ropes for access. The geology of the caves is strikingly different from that of the classical karst of the central United States. The host rock is entirely breccia, a rock type composed of broken fragments of older rocks cemented together. Other aspects of the geology seem strikingly familiar. For instance, caves follow fractures and breakdown choked passages. During our daily hikes, Lee collects rock samples of the breccias to help determine their origin and delimit geologic boundaries around the study area. Placing the samples (and the cave entrances) on a map won’t be easy, however, because our GPS units rarely get a signal beneath the jungle canopy.

Participants in VPGP expeditions usually span a variety of interests and expertise. This year is no exception. Philip (Ernie) Reeder serves as the expedition leader. Assisting him are long-time VPGP participants James (Stoops) Webster of the US-EPA in Atlanta and William (Bushman) Reynolds from the Lower Dover Research Station in Unitedville, Belize. Phil van Beynen, Associate Professor in the Department of Environmental Science and Policy at USF along with his students Jason Polk and Christian Ward are along to collect soil and speleothem samples for paleoclimate and paleovegetation analyses. Lee Florea and Beth Fratesi, PhD candidates in the Department of Geology at USF, and Cara Gentry, PhD student in Geology at University of Florida, are along to aid in cave surveys, perform geologic mapping, and collect rock samples for further analysis. Amber Yuellig, a graduate student in public archaeology from the USF Department of Anthropology, is on board to help in cave surveys and archeological assessments. Finally, two Belizeans, Junior and Dred, are along to help run camp and haul equipment.

REFLECTION CAVE: A TREK THROUGH THE BELIZEAN JUNGLE

The jungle is a typical dense forest, with strong, elastic vines. Much of the forest is high-canopy forest, easy for hiking
out that, because of the complicated profile of the pit, the radio won’t work and we can’t hear him. All this time he’s been shouting up at us and fending off a snake with a flashlight. Lee continues his descent, followed by Cara. Cara is a relative novice to vertical work, but she makes the 55-m drop with panache.

At the bottom, oxygen levels are low. The cave is beautifully decorated with stalactites, stalagmites, popcorn, and curtains. Many of the formations are still actively growing. One short passage follows a fault visible in the ceiling. Angular rock walls create a triangular passage with dense soda straw formations hanging from the angled ceiling and stalactites ornamenting the sides. At ten minutes to noon a beam of light lasers down through the pit and hits the cave floor. The beam of light—the only direct light available from the surface—is about ten inches in diameter, and transient. We watch, transfixed, as the light pulsates with the passing of clouds overhead. By ten minutes after noon, the show is over. We resume the survey, stopping occasionally to photograph the formations.

The entrance to Chen Ha is located just below the apex of a razorback rock-strewn ridge from which we can see over the canopy to the forested mounds of Ix Chel. Having a field of vision greater than a few dozen meters is a welcome sight in the study area, so we spend a moment on the ridge top savoring the view. The entrance to Metate Cave is a small hands-and-knees crawl on the hillside below. Once inside the first room of the cave, we have to crawl through a man-made wall of rocks to get to the back of the cave. The rocks are not all that the Maya left in this cave. Amber points out shards of pottery scattered about the floor and an intact metate used for grinding a variety of food and plant materials. Many caves utilized by the Maya contain manos (the hand-held grinding instrument) and metates that may have been placed in the caves for ritualistic purposes. Amber’s excitement becomes apparent as she points out the significance of the artifact. The metate is granite, used instead of limestone because of its durability. Since the only source of granite is the Maya Mountains to the east, it is a clear indication of thriving trade
between the Maya of Ix Chel and the cities of the powerful state of Caracol.

Metate Cave is small and an easy 75-meter survey. It consists of one room heavily decorated with old, dry formations. The floor is a talus slope heavily modified by the Maya. Piles of rocks are arranged as walls separating the room into chambers on various levels. Amber, Beth and Christian complete the survey while Ernie starts digging a trench to take soil samples. As he explains it, the soil is for paleoclimate work of another sort.

The erosion and deposition of surface soils in caves often preserves a record of the environmental history of the land above the cave. Cave sediments can provide excellent records of terrestrial changes in vegetation and land use, commonly not preserved in ever-changing surface soils. Caves of the Vaca Plateau contain organic-rich, clay soils located near ancient Mayan agricultural terraces, therefore sediments washed into caves can also be indicative of changes in land use and agriculture. For instance, deforestation and agriculture increases erosion of the soil into caves. The amount of $^{13}$C (a heavy isotope of carbon) present in organic acids of the sediment is directly related to the type of plants growing in the soil during deposition. Variations in the $d^{13}$C of cave sediments can provide a record of vegetation change above the cave. For example, dense forests produce a sediment with a lighter (more negative) $d^{13}$C value, whereas vegetation thriving in a more arid environment, such as grasses and maize, produces sediment with a heavier (less negative) $d^{13}$C value (Huang et al. 2001). By radiocarbon dating the layers of cave sediment and correlating these dates to the $d^{13}$C record, a temporal record of erosion and vegetation changes can be established (Schwarcz and Rink 2001). Ernie collected soil samples in three caves to construct records such as these.

**BIG MOUTH AND BUSHMAN CAVES: GATHERING THE EVIDENCE OF CHANGE**

During another long hike, we visit two more caves south of camp. The entrance to Big Mouth Cave is a steep slope adjacent to an overgrown logging road. Stalactites and columns guard the cave like teeth. Inside, the ceiling and floor are geometric opposites and create a surreal landscape. Thick formations cover all available space above, and thick horizontal sediments cover the floor. Van Beynen, Ernie, Jason, and Christian spend some time excavating trenches for soil sample collection. This site, along with Reflection and Metate Caves, will be the focus of the soil studies. The soils analyzed at USF reveal interesting trends and peaks that suggest changes in sedimentation rates and vegetative cover during the past 3,500 years. This information, coupled with data produced via speleothem analysis, will help us better understand the evolution of the natural and cultural landscapes, not only in the study area, but the larger Maya Region.

On our way back to camp we stop at Bushman Cave to collect sediment samples. The sediments that cover the floor of Bushman Cave are unusual in that they are almost entirely organic. Crawling single-file through the entrance passage of this cave, we notice several nest-like piles of leaves that might be the source of these organisms. They are gibnut nests. A gibnut is a large rodent weighing about 20 pounds, roughly the size of a cocker spaniel. Gibnuts are beautifully colored animals with reddish-brown fur and white spots and stripes. They are typically burrowing animals, but will make use of caves when possible.

As we near the back of the cave, we realize that one of the nests is still occupied. We've cornered a gibnut in the cave and, with nowhere else to go, it rushes past us and out the entrance. While we're in the cave, Ernie collects samples to quantify the percent organic matter content, as well as the nature of these unusual sediments.

**IX CHEL QUARRY: TELLING A GEOLOGIC STORY**

By May 8th, most of us were yearning for a change of pace and for opportunities close to camp. Several opted to take the day to tour sites within Ix Chel. The building stones comprising the structures, on close inspection, are surprisingly different from the rest of the bedrock around the study area. Rather than a breccia, the building stones are marl. The soft and powdery marl is easy to extract, cut to size, and carve; a vast improvement over the dense, tightly-cemented breccia. The Maya recognized this and sought sites to obtain the marl for construction. As expected, members of the VGPG have identified an ancient quarry a few hundred meters from Ix Chel. It is here that Lee explains some of the clues that he has uncovered related to the geology.

Contacts between rock types are important tools for understanding the geology of a study area. It is these features that tell us how one cycle of rock formation ends and another begins. Marls such as those at Ix Chel, with considerable clay minerals, form under very different environmental conditions than the breccia. Whereas the marl was likely deposited where terrestrial river sediments mixed with carbonates produced by ocean-dwelling organisms, the origin of the breccia is unclear.

Forming a breccia requires that an original rock be broken into fragments, and that these fragments travel short distances (a long distance would round the edges of the rock fragments). A breccia that covers a small geographical area is easily explained; perhaps an ancient landslide or cave collapse occurred. However, the gray, gray-brown, and tan breccia of the Vaca Plateau is widespread and very thick. It is part of the Cretaceous age Campur Formation exposed over a large part of northern Guatemala and western Belize (Vinson, 1962). Underneath the breccia is the older Coban Formation also of Cretaceous age; a crystalline, grey to pink, layered limestone. The contact between the Campur and Coban Formations hides beneath the soil between the Ix Chel and the Spanish Waterhole. Below the carbonates are metasediments of the Santa Rosa Group, eroded during the Triassic and Jurassic from the Permian-age granites of the Maya Mountains.
Large volumes of breccia like the Campur Formation require vast upheaval of the landscape. The intriguing question is how quickly the breccia developed. Evidence from the caves visited during this expedition demonstrates that there are contacts in the breccia, indicating more than one event. The question now becomes whether these events all happened in a week or whether they occurred over the course of millions of years. It is worth mentioning that the Chicxulub impact crater, also of Cretaceous age, and known to have formed massive breccia in the Yucatan, is only a few hundred kilometers away. We will search for additional clues within 25 of the 41 samples obtained during the expedition using extremely thin, polished samples and microscopes.

**RETURNING TO TRES RIOS CAMP: THE CULTURAL CLASH OF THE "NEW" MAYA**

Our trip back to San Ignacio on May 10th is a trek forward through time, and the distinction between the abandoned Ix Chel site and the bustling San Ignacio is striking. The landscape is again an agricultural one, but ecotourism is the cornerstone of today's economy. During our last few days in Belize, based out of the Tres Rios Farm (owned by Bushman), we observe Internet cafés, travel agencies, trip outfitters crowd along narrow, winding streets. We spend time relaxing, reading, and taking well-deserved showers.

Maya centers such as Xunantunich and Cahal Pech, excavated and studied by the tedious work of archaeologists, swarm with tourists. Their snapshots capture the majesty of Maya architecture, but not the culture. The Maya people no longer inhabit the sites of their ancestors, but their heritage remains. Additional clues to their history remain, hidden beneath the jungle canopy within ancient structures and preserved in the soil and speleothems. Whether the Maya civilization "collapsed" due to changes in climate or overpopulation is in some respects irrelevant. The Maya live on, adapting to a new culture and new roles.

Members of the Karst Research Group at USF and the VPG are returning in March of 2005 for another field season at Ix Chel.

**REFERENCES CITED**


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**Paleoclimatе Reconstruction from Cave Sediments and Speleothems**

**Jason Polk and Phil van Beynen**

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The cave sediments and speleothems collected in Belize during May of 2004 by Jason Polk, Philip van Beynen, and Christian Ward were brought back to the University of South Florida for analysis. The plan was to use the cave sediments to help understand more about the vegetation changes above the caves they were collected in, while the speleothems would provide evidence for the paleoclimatic shifts in temperature and precipitation that had accompanied them.

During the summer of 2004, Jason and Christian performed several types of analysis on cave sediments from Reflection Cave which were radiocarbon dated to over 2,500 years old. They extracted the 13C from the fulvic acid in the sediments and analyzed them at the University of South Florida's Marine Science Paleolab. By combining the stable isotope record with the other radiocarbon dates, they produced a record of vegetation change for Reflection Cave which shows a major change around 2,200 years ago.

While the cave sediment record proved to be interesting, by itself the record was not informative enough, as nothing else was known about the climate record. To remedy this, Jason went to the University of New Mexico to work with Dr. Yemane Asmerom, who directs the Radiogenic Isotope Lab, to perform U-series dating on the speleothems collected from Chen Ha cave. Perhaps there would be a connection between the cave sediments and the speleothems. The dating was successful but showed that all of the samples were much too old, dating back to ~59,000 years, to provide a correlation to the Reflection Cave sediment record, which was only 2,500 years old.

Well, like all good scientists do, Jason and van Beynen put their heads together and started to look for other proxy records that would provide insight to Reflection's cave sediment record. As the light bulbs went off, they realized that Jim Webster (Stoops) had used a speleothem from another cave in the study area, Macal Chasm, for his dissertation. Macal Chasm, for his dissertation that was much younger than their speleothem samples. So, they pulled out the thick dissertation and took a look at the speleothem's 13C record and found that it was almost a perfect match over the last 2,500 years. To Reflection Cave's 13C record from the cave sediments. It will be very exciting to see what the Chen Ha speleothems reveal about the past 59,000 years—stay tuned!
Chen Ha
Vaca Plateau, Cayo District, Belize

5/6/04 survey by: Lee Florea, Cara Gentry, Phil van Beynen
Cartography by: Lee Florea, November 2004
Cave formed within the Cretaceous Campur Limestone
Surveyed length: 113.2 m
Cave depth: 59.5 m

Plan View

Key to Features
- Sediment Floor
- Bedrock Pillar
- Breccia
- Breakdown
- Flowstone
- Surface feature
- Slope
- Stalagmite
- Stalactite
- Soda Straws
- Change in Floor Elevation
- Change in Ceiling Elevation
- Survey Station
- Passage Height
- Depth Below Entrance
- Sample site (bedrock, speleothem)

Entrance
16° 52.84' N
89° 06.68' W
Elevation: 436m amsl

E-W Profile View

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