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An Archaeological Consideration of Long-Term Socioecological Dynamics on the Vaca Plateau, Belize

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In recent years, a number of eminent scholars have urged archaeologists to focus more attention on the examination of long-term socioecological dynamics, particularly because they believe that such research will generate insights that will be crucial as contemporary society attempts to deal with issues such as declining resources, environmental degradation, and climate change (e.g., Costanza, Graumlich, and Steffen 2007b; Costanza et al. 2007; Dearing 2007; Diamond 2005; Hughes 2001; McAnany and Yoffee 2010b:8; McIntosh, Tainter, and McIntosh 2000b; Redman 1999; Rosen 2007; Sabloff 1998; Scheffer 2009:250; van der Leeuw and Redman 2002:597; Wright 2004; Young et al. 2007:449–50). According to John Dearing (2007:23), the ultimate goal of this research program is not to "predict the future, but [rather to] be able to identify, justify, and rank alternative futures for humanity to work toward." Our contribution to this endeavor emanates from several multifaceted research programs focused on the Vaca Plateau of west-central Belize, where we are attempting to produce a long-term, fine-grained understanding of the emergence, florescence, and eventual decline of ancient Maya communities (A. Chase and D. Chase 2000, 2009a; Iannone and Awe 2010; Iannone et al. 2009; Moyes et al. 2009; Polk, van Beynen, and Reeder 2007; J. Webster et al. 2007). This chapter introduces the five key research foci that comprise our current data set, and provides a preliminary synthesis of our findings.

THE DATA SETS

Ranging from 300 to 560 m above sea level, the Vaca Plateau is characterized by well-drained, karstified

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limestone residual hills, dry valleys, a myriad of sinkholes and deep caves (Polk, van Beynen, and Reeder 2007:55; Reeder, Brinkmann, and Alt 1996:121, 125), and little in the way of surface water (Miller 1996:103; Reeder, Brinkmann, and Alt 1996:128). The regional climate is tropical, with marked rainy and dry seasons, annual rainfall generally falling between 2,000 and 2,400 mm, and a temperature range of 42° to 102°F (Johnson and Chaffey 1973:11). Precipitation is generally localized to individual valleys, and overall the region is highly variable and "unpredictable" when it comes to climate (Penn, Sutton, and Monro 2004:23). Similarly, soils suitable for agriculture are "often scattered" and found in "small pockets" (Wright et al. 1959:180). The natural vegetation is subtropical to tropical rainforest, with numerous palm species as well as mahogany, Ceiba, sapodilla, Spanish cedar, and fig.

In cultural terms, the Vaca Plateau was once home to a number of significant Maya centers (Figure 13.1), including Minanha, Camp 6, Ixchel, Caledonia, Caballo, and the sprawling metropolis of Caracol (which includes Hatzcap Ceel, Cahal Pichik, Ceiba, Retiro, San Juan, La Rejolla, and New Maria Camp within its confines). In the past, much of the settlement in the Vaca Plateau was tethered to areas with permanent water sources, such as springs, and terrain that had slope and soil characteristics that were suitable for constructing agricultural terraces (A. Chase and D. Chase 1987, 1998a; Iannone 2005). The specific region that is the focus of the current study is bounded by the Belize Valley to the North, the Macal River to the East, the Belize/Guatemalan border to the West, and the ancient Maya center of Caracol to the South. Five major paleoenvironmental and sociocultural data sets have been generated in this region in recent years. These data sets will now be introduced prior to presenting a synthesis of our shared findings.

Macal Chasm

The first data set that we wish to discuss derives from the detailed analysis of a stalagmite from the Macal Chasm Cave carried out by James Webster, George Brook, and their team over the last decade (Webster 2000; J. Webster et al. 2007; see also Moyes et al. 2009:197–200). The aim of this research has been to reconstruct the paleoclimatic history of the region, with particular emphasis on documenting periods of severe drought. In the last two decades, cave stalagmites have emerged as one of the most important sources of high-resolution paleoclimatic data because they can be dated extremely accurately by ICPMS Uranium-series methods. In addition, some stalagmites have discernible annual and even subannual layers allowing precise sampling of proxy

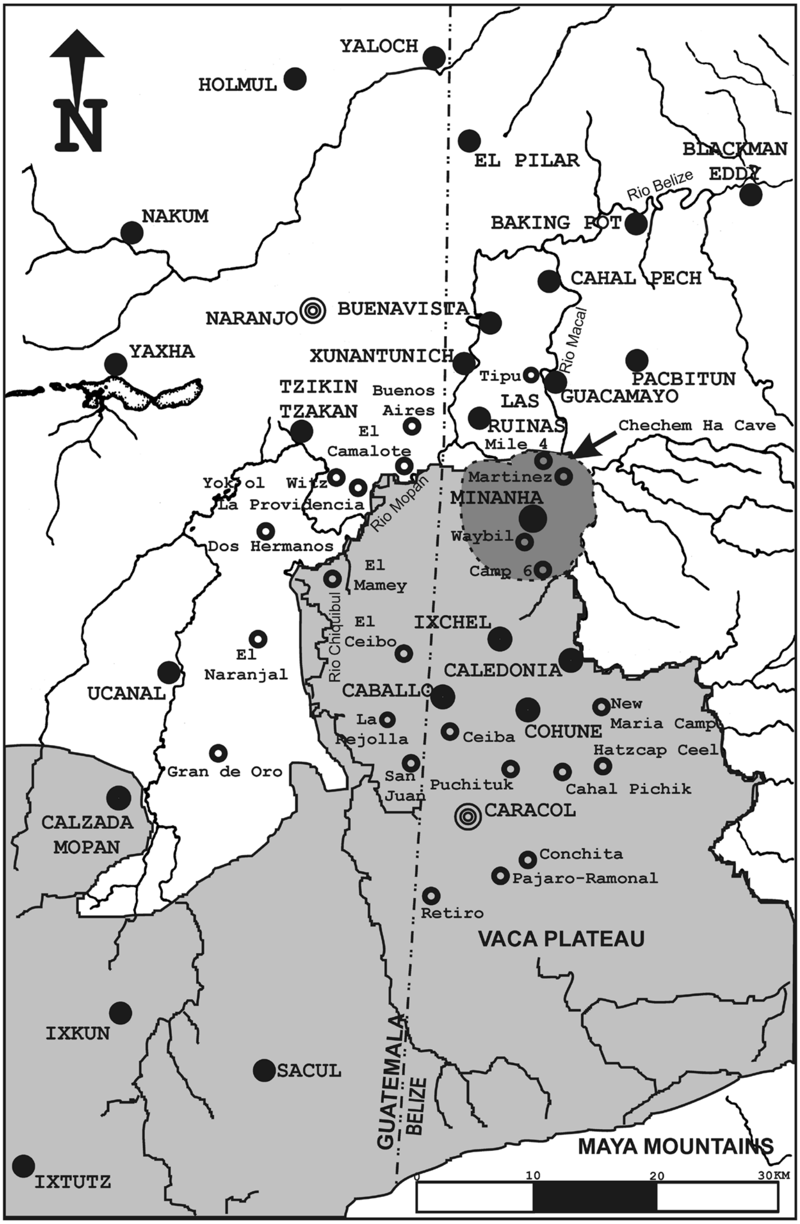

FIGURE 13.1. *The Vaca Plateau showing the main sites discussed in the text, including the "great kingdoms" of Caracol and Naranjo, other "little kingdoms" (dark circles), and key "minor centers" (light circles).*

climate variables (e.g., Brook 1999; Brook et al. 1992). Stalagmites near cave entrances may also contain pollen grains that can provide information on past vegetation near the cave (e.g., Brook and Nickmann 1996; Burney, Brook, and Cowart 1994). Grayscale reflectance and UV-induced luminescence of the cut surface of a stalagmite can provide information on detrital material and organic acids in the carbonate, respectively, with the former indicative of either wet (large grains) or dry (dust) conditions (Railsback, Brook, and Webster 1999), and the latter a measure of vegetative activity in the soil above the cave, and thus climate conditions. Although many factors can affect $\delta^{18}O$ and $\delta^{13}C$ of stalagmite carbonate, $\delta^{18}O$ usually responds to changes in precipitation, particularly the amount and intensity of rainfall. In contrast, $\delta^{13}C$ records changes in hydrology above the cave that affect the exchange of C isotopes between meteoric waters, soil carbon dioxide, and the bedrock. In areas with a mix of C3 and C4 plants, $\delta^{13}C$ can sometimes provide information on the percentages of each type in the vegetative cover (Brook 1999).

Located circa 15 km north of Caracol, 10 km southwest of Minanha, and 50 m from Ixchel (also know to locals as El Corral), the Macal Chasm is situated at 520 m above sea level and consists of a vertical shaft 5 m wide and 40 m deep that opens into a large chamber (Figure 13.2). The focus of the research is an active stalagmite 92 cm long that was collected circa 8 m from the vertical shaft. This stalagmite was chosen because its location next to the shaft meant that it would have been susceptible to environmental changes outside of the cave (J. Webster et al. 2007:3).

Following its collection, the stalagmite from Macal Chasm was cut in half along the growth axis and subjected to a number of tests and dating techniques. Dates were obtained using radiocarbon, U-series, and ^{210}Pb (lead isotope) techniques. In the end, the radiocarbon dates—which included five accelerator mass spectrometry (AMS) and two radiometric dates—were not used to build the chronology, but they were in general agreement with the ^{210}Pb and U-series dates (J. Webster et al. 2007:7). Other forms of analysis included petrographic and X-ray diffraction, reflectance (grayscale), color (indexed color scale), luminescence (long-wave ultraviolet light), and both carbon and oxygen stable isotope ($\delta^{13}C$ and $\delta^{18}O$) assessments.

In terms of results, petrographic and X-ray diffraction analyses indicate that the layers in the speleothem that are rich in fine detritus are probably indicative of drier periods. Such detritus reflects dust deposition when the drip rate slowed or possibly even stopped altogether. In contrast, dense, clearer calcite layers with scattered, coarser detrital grains are suggestive of wetter conditions and a continuous flow of drip water (J. Webster et al. 2007:9). The

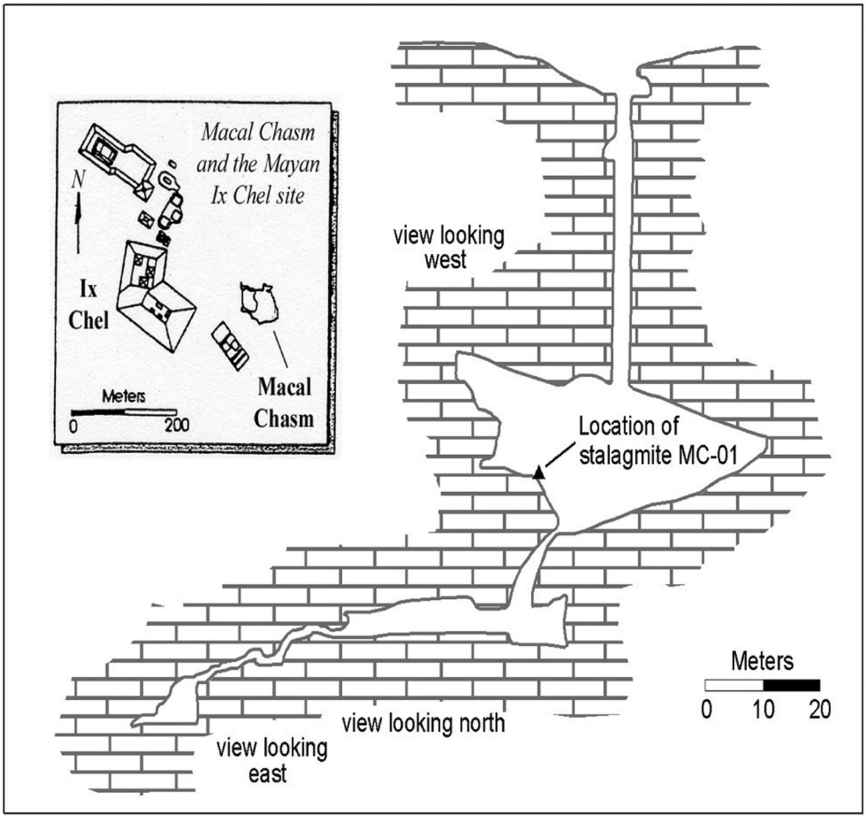

Figure 13.2. *Cross-section through the Macal chasm showing the location of the sampled stalagmite (inset shows the location of the Macal chasm in relation to Ixchel).*

luminescence, color, and $\delta^{13}C$ and $\delta^{18}O$ in the CaCo3 of the stalagmite provide complementary proxies for paleoenvironmental conditions in the area surrounding the Macal Chasm (J. Webster et al. 2007:12), with lesser luminescence, browner colors, and increased $\delta^{13}C$ and $\delta^{18}O$ levels all being indicative of drier and potentially cooler conditions. Nevertheless, the data sets are not in perfect concordance, primarily because they have different resolution levels. The luminescence and reflectance data have a spatial resolution of ~0.18 mm (approximately 11 pixels), whereas samples for isotope analysis were drilled at 5 mm intervals along the stalagmite growth axis with a sample resolution of 2 mm, the diameter of the drill bit. Therefore, based on the chronology of the stalagmite, the isotope data have a temporal resolution of circa 5–30 years at circa 10–70 year intervals, and the color and luminescence data have a resolution of 0.5–3 years. The luminescence record is the most effective proxy because of its higher resolution and marked peaks and valleys (J. Webster et al. 2007:12). Ultimately, the Macal Chasm provides a 3,300-year record of paleoclimatic change, from 1225 BC to the present.

Reflection Cave and Ixchel

The second data set to be presented was generated by Jason Polk and his team, who collected cave sediments from Reflection Cave in 2004 in order to assess vegetation changes caused by both climate and anthropogenic factors (Polk, van Beynen, and Reeder 2007), and by Iannone, whose research project conducted preliminary excavations in the eastern shrine complex and ballcourt within the Ixchel epicenter in the summer of 2011 (Figure 13.3). Reflection cave is located 3 km southeast of Ixchel, and the cave's sediments are thought to contain a record of the expansion and contraction of the latter center's agricultural activities over time. Although the results of the preliminary excavations at Ixchel will not be detailed here, revisions to the developmental sequence crafted by the Reflection Cave team will be provided where necessary.

Reflection cave itself has an vertical entrance 11 m long and with two passages at its base (Figure 13.4; Polk, van Beynen, and Reeder 2007:56). Fifteen sediment samples were collected at about 5 cm intervals from a deposit that was about 82 cm thick (Polk, van Beynen, and Reeder 2007:56). Accelerator mass spectrometry dates were obtained from organic materials, such as seeds and charcoal, from nine different layers. The basic premise of the research is that because cave sediments are created through the allogenic deposition of surface soils in cave contexts, these sediments reflect the environmental history of the surrounding landscape, including records of vegetation changes that can be used to infer the intensity and nature of agricultural practices (Polk, van Beynen, and Reeder 2007:55). The specific method employed by the research team is based on the examination of the variations in the $\delta^{13}C$ values (carbon isotopes) of the fulvic acids contained in the decaying organic materials within the cave sediments. Fluctuations in these fulvic acids are proxies for vegetation change caused by both cultural and climate influences, as they are tied to shifts in the frequency of C3 and C4 plants, the former representing the "natural" vegetation of the study area (depleted $\delta^{13}C$ values) and the latter being more indicative of Maya agriculture (enriched $\delta^{13}C$ values; Polk, van Beynen, and Reeder 2007:53, 55, 58). The research team does provide one caveat, namely that "It is doubtful, due to the steep topography of the study

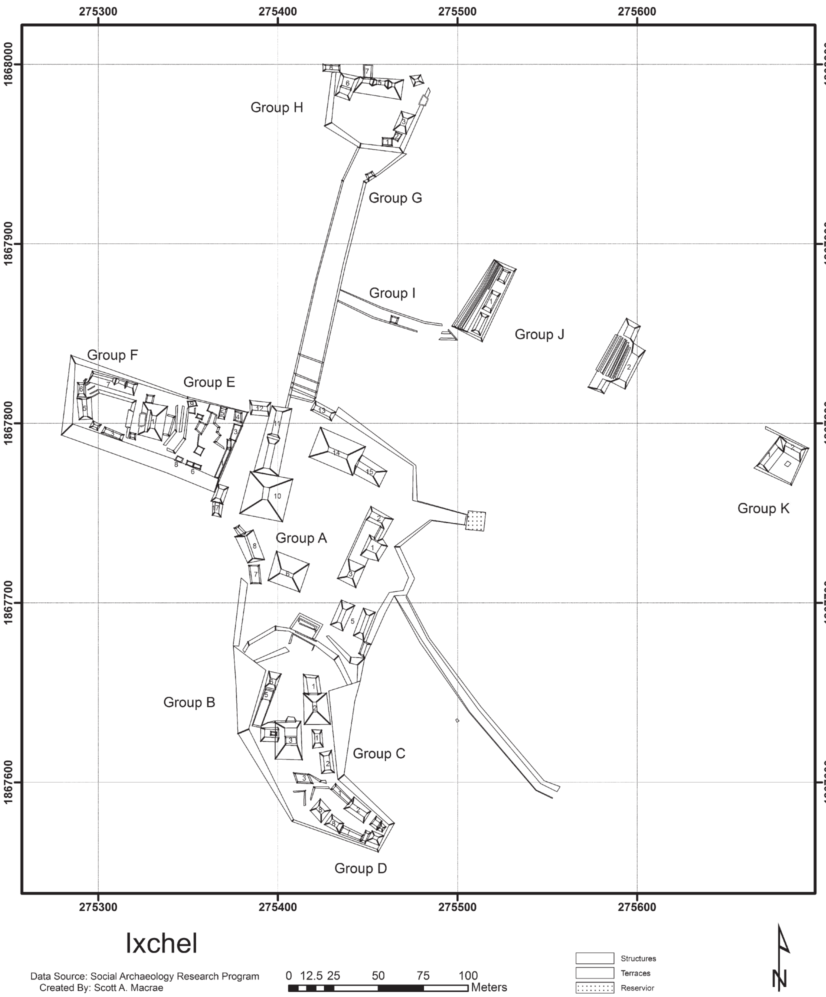

Figure 13.3. *Rectified isometric plan of the Ixchel site core.*

area and amount of vegetation cover, that a complete shift to agricultural (C4) vegetation occurred" (Polk, van Beynen, and Reeder 2007:58). In other words, even during peak Maya occupation, there were probably both terraced and unterraced slopes, something also clearly seen on the edges of Caracol (Chase et al. 2011).

The Reflection Cave data provides a sequence of vegetation change spanning the period between 600 BC and AD 800. Although the researchers

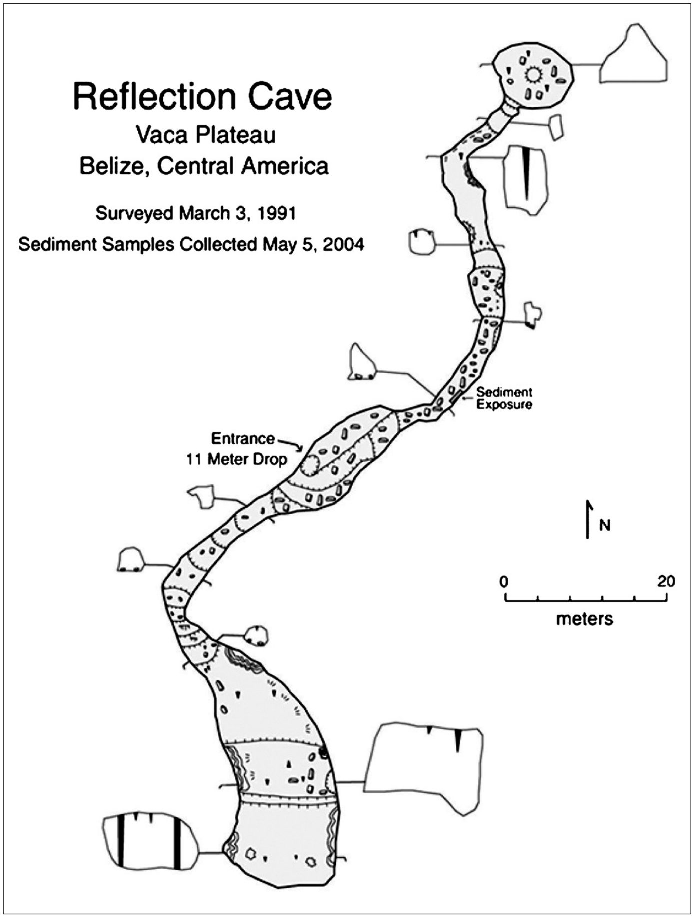

Figure 13.4. *Plan of Reflection Cave showing the location where the tested sediments were collected.*

suggest that these changes were, to a certain extent, the result of anthropogenic factors, they posit that the ultimate cause was the amount of water that was available. In other words, declines in agriculture were tied to periods of "prolonged aridity," whereas wet periods led to an expansion of agriculture (Polk, van Beynen, and Reeder 2007:59). The research team also concluded that "highland" centers such as Ixchel would have been among the first to be abandoned, once droughts took hold, "because minimal water resources would have been available in this highly karstified, well-drained area, and supplemental groundwater extraction would have been difficult due to the extreme depth of the water table" (Polk, van Beynen, and Reeder 2007:53).

Chechem Ha Cave

The third data set that we will discuss emanates from the research conducted by Holley Moyes and Jaime Awe of the Western Belize Regional Cave Project, who conducted a detailed examination of Chechem Ha Cave over the course of four field seasons, between 1998 to 2003 (Moyes 2006a). Chechem Ha Cave is situated on a hill about 370 m above sea level, on the western side of the Macal River, about 6.5 km northeast of Minanha and 15 km northeast of Ixchel. It is also in close proximity to the sites of Las Ruinas and Chan, so it is unclear as to which site or sites were using the cave. In addition, it is currently not possible to determine which groups may have been using the cave, although the presence of numerous Early and Late Classic polychrome vessels, earth-moving activities, a large deposit of boulders in the entrance, and what may be a small uncarved stela suggests that local elites used the site (Awe et al. 2005). As important political spaces, it would be unlikely for commoners to have control of these powerful ritual cave settings. This supposition is further supported by virtually all ethnographic accounts of cave ritual, which demonstrate that even today caves may be entered only after receiving ritual permission sought by ritual specialists or high-ranking community officials (Moyes 2006a:33–45).

Chechem Ha Cave itself is 198 m in length and has over 300 m of tunnels (Figure 13.5). The field research included mapping of the entire cave system, artifact plotting, test pitting, broad horizontal excavations, and chronology building using 44 AMS dates and ceramic analysis. Point plotting and quantification of charcoal flecks were also carried out using photomapping GIS technology and "density difference maps" (Moyes 2006a, 2007, 2008; Moyes et al. 2009:183–87).

The primary goal of the Chechem Ha research was to assess changing ritual practices over time, with particular emphasis on how these articulated with sociopolitical and environmental trends. Of particular interest was that many paleoclimatic studies had implied that the Late Classic collapse was brought on by climate change, especially drought. Holley Moyes (2006a, 2007) argued that if this did occur, a loss in faith, not just in the rulers, but in the nature of rulership itself, would have been a likely outcome. Few studies supported this supposition (Moyes et al. 2009:176), and to fill this lacuna, studies of ritual caves provided the ideal setting to explore the "loss of faith" model, given that

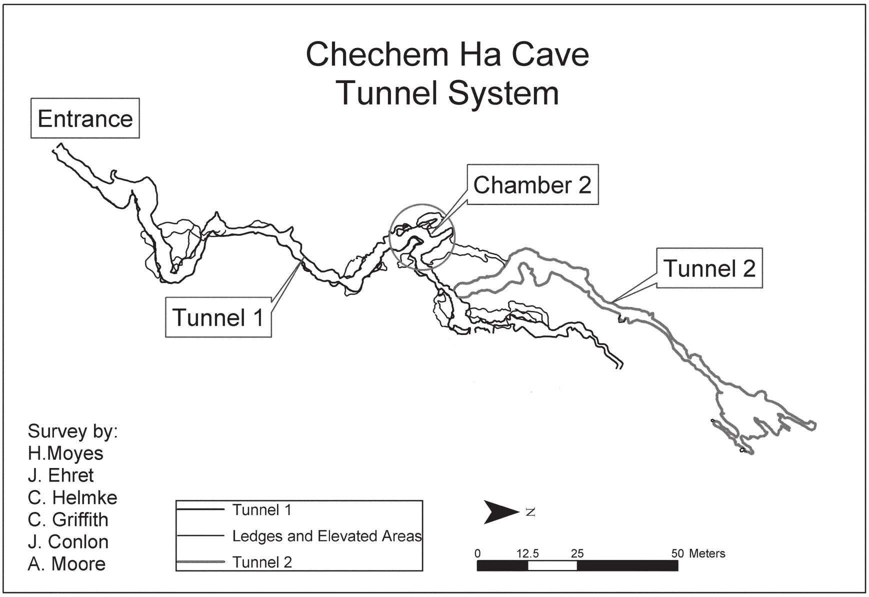

Figure 13.5. *Plan and cross-section through Chechem Ha Cave.*

there is a well-documented ideological connection between caves, water, and agricultural fertility. It was postulated that during times of crisis, people often react by elaborating or otherwise changing their ritual activities and that this should be apparent in the artifact and ecofact assemblages within the cave. Specifically, it was suggested that when droughts occurred one could potentially see changes in ritual practices, including an increase in harvest rites such as first-fruit ceremonies (as evidenced by deposits of underdeveloped ears of corn, for example), because of the close connection between rainfall, fertility, and agriculture. In addition, caves would be important settings for such rituals because they are connected ideologically to first maize and contain "primordial water" (Moyes 2006a, 2007:218–19, Moyes et al. 2009:181, 190–93). But more important, because caves use could be affected by local or regional depopulation, they served as multifunctional ritual spaces and were the venues for rites that could have political or religious undercurrents. In the end, a direct one-to-one correlation between climate and use intensity was not expected at Chechem Ha's over its 2,000-year history, and no single factor was expected to drive changes in ritual practice (Moyes 2006a:559).

Key to the investigations was the concept of ritual use intensity, which assesses the frequency of, length of, or number of participants involved in ritual performance over time by quantifying and analyzing material remains. Use-intensity proxies included ceramics, with whole or partial vessels serving as *direct* proxies—they are part of the ritual itself—and charcoal flecks serving as *indirect* proxies—being deposited by torches used to light the dark zones of the cave during rituals (Moyes 2006a, 2007:217, 220, 2008:139,1440; Moyes et al. 2009:177, 183).

The research documented temporal shifts in ceramic and charcoal fleck depositions, as well as spatial usage of the cave. These data allowed for the formulation of a detailed sequence for changing ritual use of Chechem Ha Cave that covered the time span between 1200 BC and AD 960. Of particular interest are ritual changes that occurred in conjunction with a series of droughts that occurred in the eighth and ninth centuries, the time period associated with the infamous Maya "collapse." Moyes and her colleagues concluded that the shift in ritual practices at this time provides evidence for the emergence of a "drought cult" and that the collapse therefore coincided with a time at which the elite were perceived to be failing in terms of their ritual obligations; they could not make it rain in a period of incessant drought and their support populations lost faith in them (Moyes 2006a, 2007; Moyes et al. 2009:201).

Minanha

The fourth data set that will be discussed derives from the ancient Maya site of Minanha, a small center that was once strategically situated in the frontier zone bordering the powerful, and antagonistic Caracol and Naranjo polities. Located about 25 km northeast of Caracol, 10 km northeast of Ixchel, and about 6.5 km southeast of Chechem Ha Cave, Minanha has been the setting for detailed archaeological research by Gyles Iannone and his team for the past thirteen years. The goals for this research have been twofold: (1) to acquire a better understanding of ancient Maya sociopolitical organization and (2) to generate insights into the factors that led to the Terminal Classic collapse. Throughout the course of the project, a concerted effort has been made to generate a broad-spectrum database that is reflective of the entire Minanha community. This has involved extensive reconnaissance, detailed mapping, large-scale excavations, and comprehensive artifact analysis.

Minanha itself consists of an epicenter court complex approximately 9.50 hectares in size, with two major plazas, eight large courtyards, a ballcourt, three smaller patio groups, and eight stelae (Figure 13.6). Surrounding the epicenter is a relatively dense settlement zone comprising the site core. A 1 km² area containing the epicenter and site core contains at least 169 individual structures. The Phase I research at Minanha focused on the examination of the rise and fall of the Minanha royal court (Iannone 2005). This research involved detailed mapping of the epicentral court complex and large-scale excavations of most of its constituent buildings between 1998 and 2006. An additional series of investigations in the area surrounding the epicenter examined the complex water management system, which includes a myriad of springs, a number of natural basins in the limestone that allowed for the seasonal collection of rainwater (*sartenejas*), and two reservoirs—one small, the other quite large.

The recently completed Phase II research program was focused on the detailed mapping of two 1 km² survey zones and the excavations of a stratified sample of lower-level settlement units associated with each zone. This study was meant to provide some balance to the elite orientation of Phase I. The Phase II study had three broad goals: (1) to compare the settlement densities and composition of two settlement zones of varying distance from the Minanha epicenter, (2) to excavate a stratified sample of settlement units in both study zones, and (3) to map the large-scale ancient Maya terrace agricultural system associated with one of the settlement zones.

The first settlement zone consisted of the settlement within the 1 km² surrounding the epicentral court complex (Longstaffe and Iannone 2011). In total, 39 individual units were included in the site core zone study, comprising 115 individual structures. A 20 percent sample (stratified by settlement unit type) of the overall population of settlement units (n = 8) was selected for detailed excavations. The second Phase II settlement zone was located about one kilometer southeast of the epicenter and was centered on the Contreras Valley, which is one of the most intensively terraced areas in the vicinity of Minanha (Macrae and Iannone 2011; McCane, Macrae, and Iannone 2010). Ninety-eight settlement units, comprising 183 individual structures, were mapped in this zone. A 15 percent stratified random sample (n = 15) of these settlement units were selected for detailed excavations. In addition to the settlement study, the Phase II research involved detailed mapping and test excavations within the Contreras Valley's extensive terrace system, which would have been integral to the growth and perpetuation of the ancient Minanha community. In summary, thirteen years of research at Minanha has generated a detailed sociocultural sequence spanning the time period between 500 BC and AD 1200. The formulation of this developmental sequence has been aided by ceramic analysis and radiocarbon dating.

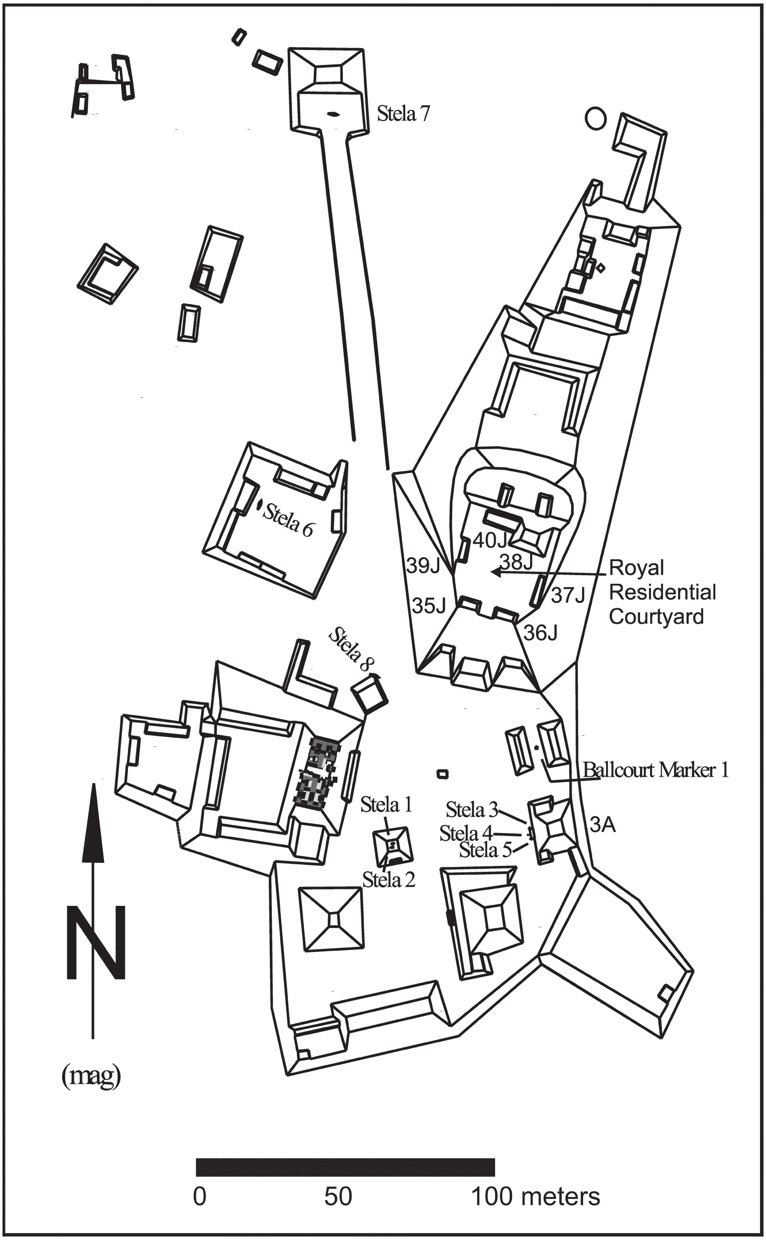

Figure 13.6. *Rectified isometric plan of the Minanha Site core.*

Caracol

The fifth and final data set that will be considered is derived from Caracol, an ancient Maya metropolis that covers some 200 km^2 of the Vaca Plateau. The metropolitan area that comprised the site was integrated by means of an extensive causeway system that linked both earlier architectural concentrations and purposefully built architectural nodes into a single urban system (Figure 13.7; Chase and Chase 2001, 2007a; Chase et al. 2011). The landscape was completely anthropomorphized through the creation of agricultural terracing that contributed to the sustainability of the individuals inhabiting this part of the Vaca Plateau (Chase and Chase 1998a). The site also contains an extensive corpus of stone monuments and hieroglyphic texts (Beetz and Satterthwaite 1981; Chase and Chase 2008) that confirm that it was a major political power in the Southern Maya lowlands during the Early and Middle Classic periods (from ca. AD 200–680), presumably contributing the founding ruler for Copan, Honduras, in AD 426/427 (Price et al. 2010); benefiting materially from defeating Tikal, Guatemala, in war in AD 562 (Chase and Chase 1989); and incorporating Naranjo, Guatemala, into its broader political unit from AD 631 through 680 (Chase and Chase 2003b).

A long-term, large-scale research project directed by Arlen and Diane Chase has been investigating Caracol annually since 1983 (http://www.caracol.org). Investigation foci have rotated between excavation programs located in and around the site epicenter and work further afield in termini groups and areas of outlying settlement. When initially established, the goal of the project was to compare and contrast the hieroglyphic history found on Caracol's monuments with the archaeological record. Caracol Altar 21, with its record of a "star-war" at Tikal, provided the backdrop for settlement research in the southeastern part of the site designed to test the effects of successful warfare on Caracol's inhabitants (Chase and Chase 1989); subsequently, the northeast sector of the site was similarly tested (Chase and Chase 2003b). As a result of this research, it proved possible to define a Caracol identity and to show how it functioned to better integrate that site's inhabitants (Chase and Chase 2009b; D. Chase and A. Chase 2004a). As a result of twenty-seven years of settlement research at Caracol, 23 km^2 of the site and 4 km^2 of terraces have been mapped, some 120 residential groups have been archaeologically investigated, and archaeological data have been gathered from the Retiro, Ceiba, Pajaro-Ramonal, Conchita, Puchituk, and Cahal Pichik Termini. It has been estimated that some 9,000 residential groups, containing minimally 36,000 structures, comprised Caracol's outlying settlement (Chase and Chase 1994); these initial estimates received confirmation in data gained from airborne

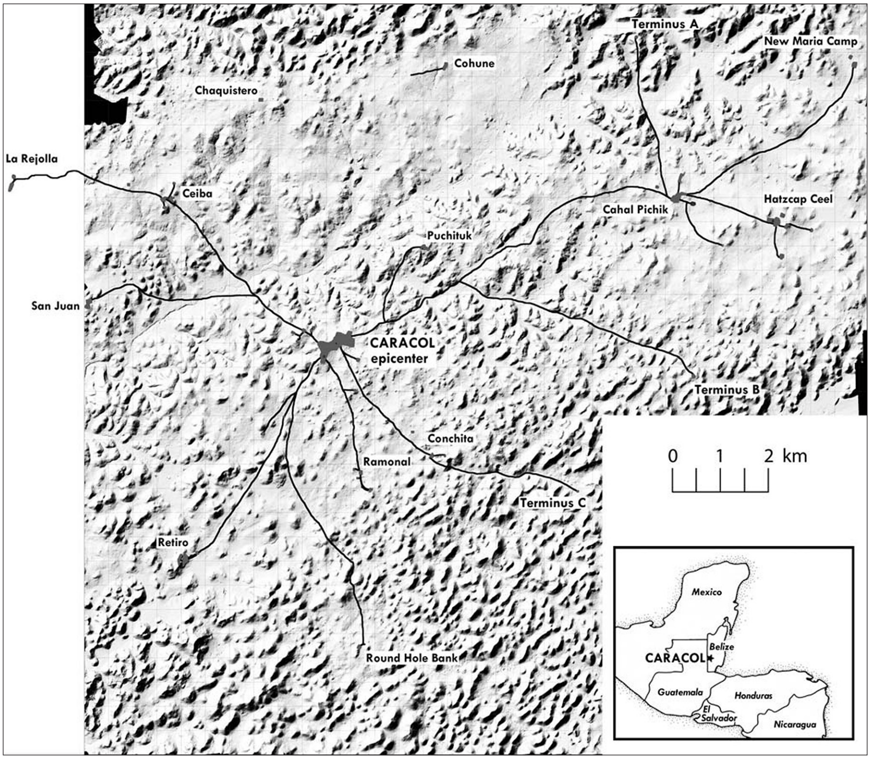

Figure 13.7. *Caracol and its causeway system.*

Light detection and ranging (LiDAR) in 2009 that provides detailed settlement and terrace data for a 200 km^2 area and fully situates Caracol's human-made features in terms of the associated landscape (Chase et al. 2011).

Archaeological work in Caracol's epicenter has resulted in the archaeological excavation in almost all of its public architecture, including Belize's tallest human-made complex, Caana (rising some 43.5 m above its facing plaza). Most of the site's epicentral palaces have been aerially excavated, and the artifactual materials on their floors have contributed to our understanding of the social complexity involved in the Maya collapse, permitting the definition of a Terminal Classic ceramic subcomplex that was used by the site's latest elite (A. Chase and D. Chase 2004b, 2007b). Almost all of the smaller structures in and near the epicenter have also been archaeologically tested in order to look for kitchens and to assess the existence of attached specialization; this research is part of a broader focus on Caracol's economic system and how goods were produced and distributed over its landscape (Chase and Chase 2007a). The epicentral research has also benefited from two major stabilization efforts, one in the 1990s (Chase and Chase 1991) and another in the early 2000s (Awe 2007). As a result of this quarter century of archaeological research, a developmental sequence for greater Caracol has been produced that spans the period between roughly 600 BC and AD 900.

SOCIOECOLOGICAL DYNAMICS IN THE VACA PLATEAU

In the remainder of this discussion we will provide a very preliminary, and far from comprehensive, synthesis of the various data sets that were just presented.

Transition from the Early Preclassic to Early Middle Preclassic (ca. 1150–850 BC)

The Macal Chasm stalagmite suggests that the period between 1150 and 850 BC—the transition between the Early Preclassic and the Early Middle Preclassic—was comparatively wet, though the century between 1000 and 900 BC may have been somewhat drier. The contemporaneous Chechem Ha Cave deposits show high charcoal densities but low ceramic importation into the cave from 1200 to 820 BC. This suggests that cave ritual focused primarily on visitation and performance as opposed to the presentation of votive offerings. Of interest is that these rituals occurred in the wettest area of the cave, suggesting that they were water related. There is a major change in ritual practice beginning in 820 BC that likely included a hiatus in use between 820 and 800 BC. Interestingly, none of the surface sites in the Vaca Plateau (including Ixchel, Minanha, and Caracol) demonstrate evidence for occupation at this time. As such, it appears likely that pilgrimages were being made from small communities in the adjacent Belize Valley (Moyes et al. 2009:184), where there is ample evidence for occupation at this early time (e.g., Awe 1992; Garber et al. 2004).

Latter Part of the Early Middle Preclassic (850–600 BC)

The latter part of the Early Middle Preclassic period, between 850 and 600 BC, appears to have been relatively dry, as suggested by the Macal Chasm data. The Chechem Ha Cave research suggests that there may have been a drop in usage of the cave that coincided with the drying period. Nevertheless, there is still *some* usage of Chechem Ha, though there appears to be no solid evidence for occupation at Ixchel and Minanha that can be attributed to this time period. Archaeological evidence for occupation is similarly lacking from Caracol for this time period; however, given the extensive landscape modification during later times, earlier occupation may be buried or uprooted there.

Transition from the Late Middle Preclassic to the Late Preclassic (600–100 BC)

The Macal Chasm sequence suggests that there was a return to comparatively wet conditions during the Late Middle Preclassic to Late Preclassic transition, between 600 and 100 BC. Caracol was presumably settled early in this era, and occupation dating to this time period is scattered throughout the landscape, possibly a direct reflection of these favorable climatic conditions. Data from an outlying residential group indicate that initial populations reached this part of the Vaca Plateau at or shortly after 600 BC and that they used a locally based ceramic tradition that was later supplemented by Sierra Red ceramic materials. Within the Caracol epicenter, deeply buried masonry constructions may be dated to the later part of this time period.

Elsewhere in the Vaca Plateau, the postulated shift in climate coincides with the first solid evidence for pioneer populations at Ixchel and Minanha. At Ixchel, the Reflection Cave analysis suggest that some agricultural production occurred in this vicinity before 500 BC and was followed by a major occupation. These data also suggest that there was a short period of agricultural decline between 400 and 300 BC. Although the Reflection Cave researchers favor a model in which such a decline would have been stimulated by a period of aridity, the Macal Chasm sequence does not support such a paleoenvironmental reconstruction (i.e., it was "wet" at this time). This posited decline in agricultural production therefore requires more investigation. At Minanha, a pioneer population is suggested by ceramics from this time period, specifically sherds from Sierra Red dishes, but these are rare and have only been recovered from mixed fill deposits dating to later time periods. There is no architecture at Minanha that can be solidly dated to this era. Thus, the initial Minanha population must have been quite small. At Chechem Ha Cave, this wet period is marked by labor-intensive activities and earth moving, although charcoal densities remained low.

Transition from the Late Preclassic to the Terminal Preclassic (100 BC–AD 200)

According to the Macal Chasm sequence, the transition from the Late to Terminal Preclassic—from 100 BC to AD 200—is marked by the onset of a modest drought, which eventually led into a peak drought period centered on AD 141. The environmental record from Reflection Cave suggests that major occupation of Ixchel continued through the initial drying period, but there appears to have been a short decline in agricultural production, and hence occupation, between AD 100 and 200—precisely at the time of the projected peak drought. The excavations at Ixchel confirm that there are two major construction phases during this time period, and these may be separated by a brief hiatus in construction dating to the time of the projected drought .

At Minanha, the initial drying period appears to coincide with a growth in population, as signified by the construction of a series of tamped-earth floors in the area that would, in due course, evolve into the Minanha epicentral court complex and, in the periphery, below what would eventually emerge as the largest and most complex courtyard group in the Contreras Valley. There is also some evidence to suggest that some of the earliest terrace agriculture was initiated at this time, thus beginning the trend toward greater reliance on artificial "agroecosystems" (e.g., Weisz et al. 2001:124). Still, Minanha continues to be a rather small, deeply rural community throughout this period, one that was heavily reliant on a series of scattered perennial springs for its survival through the dry and peak drought periods. Chechem Ha Cave saw little or no use from 40 BC until AD 210, though Moyes (2005) suggests that a ritual sweat-bath devoted to earth deities may have been constructed sometime between 120 BC and AD 250.

In contrast to the smaller sites, Caracol underwent major construction events during this time period. Settlement dating to this era underlies many of the major epicentral structures and platforms, and the last formal version of the Caracol E-Group, which is still visible today, was built in AD 41 to coincide with the onset of the eighth Baktun (A. Chase and D. Chase 1995, 2006). Caana, an architectural complex unique among the sites located in the Vaca Plateau, reached a height of thirty-eight meters, perhaps already indicating that a broader political unit existed in this part of the Vaca Plateau. The deposits at Caracol, as represented by both caches and burials associated with masonry constructions, indicate that the site was precocious and maintained trade connections far to the South. Material from within chultuns (small chambers cut into the underlying bedrock), both within the epicenter and from outlying settlement (Hunter-Tate 1994), also indicates a fairly widespread occupation. Thus, Caracol appears to have strengthened its sociopolitical hold in the region during this time period; whether or not this can be correlated with drought, and perhaps good management policies, is an open question.

The Early Classic to Middle Classic (AD 200–675)

The Macal Chasm stalagmite indicates that the Early Classic through the Middle Classic—a time period extending from AD 200 to 675—was, for the most part, comparatively wet. However, a significant drought event likely occurred between AD 490 and 580 (see also Dahlin and Chase, Chapter 7 in this volume), with a peak centered on AD 517.

The Reflection Cave team suggest that the first part of the time period continues to show major occupation at Ixchel, as indicated by evidence for considerable agricultural activities. They also posit that the peak drought event seems to have had negative effects on the Ixchel community. Specifically, the drought appears to coincide with a marked downturn in agricultural production and an apparent decline in population beginning around AD 500. The recent excavations by Iannone's team indicate that two major construction phases date to this time period and that a major destruction event, involving the burning of a number of temple structures in the epicenter, likely occurred sometime around AD 600, in association with the buildings from the second construction phase. Although this burning event appears to coincide with the end of the projected drought—and thus potentially later than the posited peak drought documented at the Macal Chasm and population decline suggested by the Reflection Cave data—it remains difficult to determine whether these destructive activities were stimulated by prolonged drought conditions, broader sociopolitical factors, or a combination of both.

At Minanha, there was a rapid expansion of the community with the settlement of many of the loci that would eventually develop into some of Minanha's largest and most complex courtyard groups. These were located in the Contreras Valley, the site core survey zone, and the area that would, in time, become the epicentral court complex. There is evidence to suggest that these early corporate groups expanded the system of agricultural terraces in the Contreras Valley in order to enhance its productive capacity, resulting in an even more extensive colonized landscape characterized by agroecosystems with significantly less biodiversity. In summary, there is currently no evidence for a significant sociocultural decline at Minanha due to an AD 517 drought.

Beginning with the onset of the initial wet period, Chechem Ha Cave once again became a setting for high-use intensity, as evidenced by the highest charcoal densities in the cave's history and a marked increase in the importation of ceramic vessels, though the latter were rarely complete. This shift in ritual practices is thought to represent the increasing popularity of rainmaking activities by elites, as evidenced by the increased number of Peten-style polychrome vessels deposited in the cave in wet areas. It is also worth noting that there was a gap in cave use between AD 560 and 680. Although this appears to coincide with the latter part of the peak drought era and the subsequent shift back to a comparatively wetter climate, like the burning event at Ixchel, this gap may have had cultural causes (see Moyes 2006b; Dahlin and Chase, Chapter 7 in this volume).

The era between AD 560 and 680 is exactly the time during which Caracol's expression of its own regional ritual identity was at its peak (D. Chase and A. Chase 2004a). It also coincides with what is suspected to be Caracol's hegemony over the other parts of east-central Belize and southeast Peten (although the lack of evidence for the ubiquitous Caracol "face pots" at Minanha and elsewhere suggests that this hegemony varied in its degree and physical manifestations). Archaeologically and epigraphically, Caracol reaches its height during this time period and also impacts other parts of the Maya world. It provides Copan with its founding king in AD 426/427 (Price et al. 2010). It defeats Tikal in warfare in AD 562 and materially benefits from this (D. Chase and A. Chase 2003b), and its population grew to about 115,000 people by AD 650. Caracol also maintained hegemony over the site of Naranjo for a fifty-year period, from AD 631 to 680. Rich tomb burials characterize both the epicenter of the site and its outlying settlement area (D. Chase and A. Chase 1998). Finally, the construction of the site's extensive agricultural terracing began during the Early Classic period (Healy et al. 1983). Reliance on the intensive cultivation of this increasingly artificial landscape supported the significant growth documented for Caracol at this time. Thus, if there was drought from AD 490 to 580, Caracol appears either not to have been impacted or to have used this time of stress to strengthen itself politically by focusing on exterior foes and ritually integrating its internal population (e.g., A. Chase and D. Chase 2000; Dahlin and Chase, Chapter 7 in this volume).

The Late Classic (AD 675–810)

The data from the Macal Chasm stalagmite suggest that the late seventh century and early eighth were comparatively wet. However, a series of severe droughts eventually took hold, starting as early as AD 754 and ending around AD 798, with a peak centered on AD 780. The Reflection Cave sequence indicates that the Ixchel population was in serious decline by this time, as implied by a dramatic downturn in agricultural productivity. The Reflection Cave researchers posit that the center was totally abandoned by AD 800. Iannone's recent excavations at Ixchel only isolated a single major construction phase dating to the early part of this time period, a possibly sign that the center was impacted negatively by the droughts. These investigations do, however, suggest that there was continued occupation of the epicenter, albeit without significant new construction, until roughly AD 800–850.

In contrast to Ixchel's declining fortunes, Minanha apparently flourished when other centers were being challenged by the decline in rainfall. Specifically, sometime around AD 750, the sociopolitical landscape at Minanha dramatically changed, as evidenced in the construction of the large epicentral court complex and the rapid expansion of the center's associated water management and terrace agricultural systems, the latter now covering most of the land suitable for such modification. Nevertheless, though these initiatives initially stimulated growth, they also brought greater reliance on artificial agroecosystems with less biodiversity, and they signify a period of greater connectivity and rigidity, increasing path dependency, decreasing ability to manage risks, and, hence, greater vulnerability to new perturbations (see Aimers and Iannone, Chapter 2 in this volume; Iannone, Chapter 1 in this volume). Indications are that one significant perturbation did affect Minanha sometime around AD 775, as suggested by the burning of the royal residential courtyard and the razing of its principal temple structure. This destruction activity was followed by an apparent shift to joint rule, as implied by the construction of a two-tiered throne in the courtyard's throne room. Whether these political changes were stimulated by the onset of the dry period documented at the Macal Chasm, the shifting sociopolitical landscape, or a combination of both is something that remains difficult to assess with any certainty.

Dramatic changes also occurred at Chechem Ha Cave at this time. Specifically, starting possibly as early as AD 680, though likely somewhat later, a "drought cult" may have emerged in this part of the lowlands (Moyes 2006a, 2007, 2008; Moyes et al. 2009). At Chechem Ha this is signified by changes in ritual practices, wherein first-fruit rituals became more common and wherein more complete and/or partially intact vessels, particularly water jars, were imported into the cave. At the same time, these ritual activities appear to have involved fewer people, and less time in the cave itself, as implied by declining charcoal densities. This pattern of usage is widespread, and more caves came into use during the Late Classic period than in any other temporal period in ancient Maya history. In spite of the impossibility of determining who these cave users were, specifically, it is likely that the increase in the overall number of caves in use could be attributed to shifting political circumstances and the weakening of elite power. As Lisa LeCount (1996, 1999) argues—based on her study of elite polychrome wares from the Tsak' phase at Xunantunich—from AD 780 to 890, elites began sharing power with lesser nobility and local community leaders. This is also suggested in research by Christophe Helmke and Dorie Reents-Budet (2008) on pedregal model-carved censors that are typically found in cave deposits dating to the Late to Terminal Classic periods. In a spatial analysis of their distribution in surface contexts at several sites in central Belize, they found that these vessels were most commonly found in structures belonging to lesser elites.

Elsewhere, Caracol's populations seem to have been largely unfazed by any postulated climatic changes and droughts. The outlying settlement appears to be continuously occupied throughout the region, and its terraces and reservoirs were still capable of supporting large population numbers (Chase 2012; Chase et al. 2011; Crandall 2009; Murtha 2009). However, the heavily modified landscape also locked the Caracol community into a developmental trajectory characterized by tight integration, heavy reliance on artificial agroecosystems, and likely a significant degree of vulnerability to new risks. Monument erection did come to somewhat of a halt in the early part of the eighth century, possibly because the earlier system of divine rulers may have been replaced, following the death of K'an II in AD 680, with a different form of government (Chase and Chase 2003b). Construction of public buildings, however, continued unabated; the summit plaza of Caana was raised to its final height after AD 680, but sometime prior to the onset of the Terminal Classic period. It is intriguing to realize that Caracol's monument record was kick-started again in AD 798 by new elite, who ritually desecrated slightly earlier Late Classic elite mortuary remains on Caana (D. Chase and A. Chase 2004b); perhaps this was correlated with the postulated droughts and, again, highlights Caracol's sociopolitical response to these times of potential stress. This response also involved war campaigns against Ucanal and B'ital in AD 800, recalling a similar response undertaken some 240 years earlier at the start of the Middle Classic period.

The Terminal Classic (AD 810–900)

Although the Macal Chasm stalagmite does not provide us with a firm understanding of the environmental conditions of the early part of the ninth century, indications are that the latter half of the century witnessed a return to wetter conditions. At Chechem Ha the drought cult may have continued as late at AD 810, or even though the Terminal Classic, but certainly the cave fell out of use sometime during this period, possibly as early as AD 850 and no later than AD 960. The radiocarbon assays are not fine-grained enough to produce a definitive date, though the latest sample was collected from an intact young corn cob that was possibly from a first-fruit rite that occurred between AD 720 and 960 (Moyes 2006a:555; Moyes et al. 2009:185).

The eventual shift toward a wetter climate was apparently too late for Ixchel and for the Minanha royal court, both of which were clearly impacted by the pan-lowland troubles that led to what we have traditionally called the Maya "collapse." The demise of the Minanha royal court, which likely occurred sometime in the early ninth century, is evidenced in the abrupt cessation of building projects of the elite, in the destruction of many of the center's stelae and stucco friezes, and in the burial of the center's royal residential courtyard beneath five meters of rubble. Many of the smaller and less elaborate residential groups, probably the homes of some of the poorer members of the greater Minanha community, were also abandoned at this time (Longstaffe and Iannone 2011; Macrae and Iannone 2011; McCane, Macrae, and Iannone 2010).

Significantly, a number of large, long-standing residential courtyard groups—particularly those who controlled the improved terraced lands as a result of the principle of first occupancy (McAnany 1995; Yaeger and Robin 2004), who had unfettered access to smaller-scale but still reliable water sources (such as perennial springs), and whose base of support was grounded in more traditional kin-based power structures—continued to live on, and even flourished, following the demise of the Minanha royal court (Longstaffe and Iannone 2011; Macrae and Iannone 2011; McCane, Macrae, and Iannone 2010).[1] This scenario fits surprisingly well with the "remember" concept of panarchy theory (see Aimers and Iannone, Chapter 2 in this volume). These Terminal Classic occupations are suggested by a fairly consistent material culture signature that includes scored censers, grater bowls, red-slipped dishes with double-line incised oven feet and/or exaggerated basal notching, C-shaped structures, and pseudoveneer construction methods. In the end, the Terminal Classic "collapse" at Minanha involved a process of societal "compression," in which the extremes of the community were impacted most negatively—specifically, the nobility, who were in essence "unproductive," and the poorest commoners, who had little if any control over land or water (i.e., the most vulnerable segments of the community; Longstaffe and Iannone 2011). The collapse sequences of a number of other Maya centers, such as Dos Pilas (Palka 2003:126–32) and Xunantunich (Ashmore, Yaeger, and Robin 2004:321–22), also appear to involve a similar process of societal compression.

Various scenarios may be offered to account for the so-called collapse at Minanha. In the end, the decline may have been about water, land, and politics. The sociopolitical apparatus for this part of the Vaca Plateau was heavily reliant on perennial springs and rain-fed reservoirs, and the droughts of the late eighth century through early ninth would have caused considerable stress (Lucero 2002). The fact that most of the useable land had long been under intensive agriculture may have also pushed the system into a state of diminishing returns (overcultivation may have led to soil exhaustion and declining yields, and there was likely no good land to expand into or to annex by the onset of the ninth century), precisely at a time when populations and interpolity competition were at their peak (e.g., Tainter 1988). Minanha's elite seem to have responded poorly (at least in etic terms) to the aforementioned issues, and likely found themselves at a competitive disadvantage—especially when compared to some of the long-standing residential groups that had more secure access to improved land and perennial springs and were more firmly grounded in traditional, kin-based economic (natural and human productive systems) and sociopolitical networks. Finally, it is likely significant that Minanha was a small center located in the frontier zone between two powerful and antagonistic polities, Caracol and Naranjo, both of which demonstrated renewed territorial aspirations during the Late Classic to Terminal Classic transition—precisely the time when Minanha entered its period of rapid decline. In summary, as posited elsewhere (Iannone 2005, 2010), the laborious infilling event, representing the symbolic and physical termination of the Minanha royal court, likely reflects a complex interplay of local and regional interests. Specifically, it may be the end result of the growing ineffectiveness and vulnerability of local rulers in the face of both climate change and declining productivity on the microregional scale, and the machinations of more powerful hegemonic polities seeking to secure more resources through the expansion of their tributary networks on the regional scale (e.g., Caracol and/or Naranjo)

In contrast to the above picture, Caracol continued to thrive in the Terminal Classic period. Carved monuments were erected from AD 798 through 859, though rulers shifted on a regular basis, possibly suggesting that reorganization in response to the new perturbations may have involved the shift to a nondynastic *batabil* form of government (Chase, Chase, and Smith 2009). Caracol's palaces continued to be occupied by elites through the end of the ninth century, and the kinds of remains that are found in the site epicenter are representative of widespread ties to elsewhere in Mesoamerica (Chase and Chase 2007b). Monumental construction efforts were also being undertaken at this time (Chase and Chase 2007b). Stable isotope data further suggest continuity in elite diet (A. Chase, Chase, and White 2001). Occupation of the Caracol epicenter continued through approximately AD 895, when it appears that the center may have been burnt as part of a single event and then subsequently abandoned (A. Chase and D. Chase 2007b; D. Chase and A. Chase

2000). Because of the use of a traditional ceramic subassemblage by the bulk of Caracol's inhabitants, it is difficult to know precisely when they abandoned this part of the Vaca Plateau. However, Postclassic ceramics, like those found in the Belize Valley (Sharer and Chase 1976), have not been found in the outlying settlement. The exterior orientation of the site's latest elites suggests that politics and warfare were largely responsible for Caracol's final abandonment (A. Chase and D. Chase 2004b).

The Early Postclassic (AD 900–1200)

The Macal Chasm stalagmite indicates that the period between AD 900 and 1150 witnessed a return to unusually dry conditions, with peak droughts centered on AD 910, 1074, and 1139. This final dry period, extending as it did for roughly two centuries, and being punctuated by a number of severe droughts, appears to have provided the final death blow to many of the remaining communities of the North Vaca Plateau. The population of Caracol does not appear to have survived much beyond AD 900 (although possible Postclassic ceramics were recovered by Satterthwaite in association with stelae in the Caracol A Group). If there was an AD 910 drought, it may have been severe enough in the Vaca Plateau around Caracol to have helped disrupt 1,500 years of occupation.

The situation in Caracol's karstic north was slightly different. As is typical of most cave sites in Belize, Chechem Ha was not used in the Postclassic period (Moyes 2006a; Moyes et al. 2009:184). Nevertheless, the microregion was not totally abandoned. Small groups of people continued to inhabit, and bury their ancestors in, the larger courtyard groups that were located near perennial springs and associated with the extensive terraced field system of Minanha's Contreras Valley. New settlement units were even constructed in the site core settlement zone, adjacent to Minanha's now long-abandoned epicentral court complex. Some people continued to visit the Minanha ruins, where they apparently conducted rituals involving scroll-footed vessels. Someone may have even lost a small side-notched point while on a hunting trip (though such points also occur in Terminal Classic contexts at Caracol). One individual was even buried in a haphazard fashion on the floor of the old servant's area adjacent to what was once the Minanha royal residential courtyard—their grave being made of a jumbled pile of facing stones and fill from the deconsolidating platform located immediately to the North of the burial. How these vestige communities relate to latter populations that inhabited nearby places such as Tipu (Graham 1991; Graham, Jones, and Kautz 1985;

Jacobi 2000) during the Colonial era is difficult to assess, especially because it continues to be exceedingly difficult to isolate the material residues of the Postclassic inhabitants of this region.

CONCLUSIONS

In conclusion, what we have presented here is a preliminary synthesis of the paleoenvironmental and sociocultural history of the Vaca Plateau. These data make it clear that the Maya of this region had to contend with a number of severe droughts over the course of the past 3,000 years. That the various developmental sequences presented above were crafted independently, and based on different data sets, lends credence to some of our general conclusions.

In broad terms, there is growing evidence to suggest that many of the elites of the Vaca Plateau that oversaw the Late Classic to Terminal Classic transition were ruling over polities that had entered the K-phase of the "adaptive cycle" (Holling and Gunderson 2002; Walker and Salt 2006). These rulers, and their polities, were therefore highly vulnerable because they had limited capacity to respond to changing circumstances. As discussed in the first two chapters of this volume (see also Aimers and Iannone, Iannone, this volume), the K-phase is characterized by

1. increasing intensification (e.g., via water management features and terraced field systems), which means that there are fewer resources available that are not already "locked-up," and therefore tightly controlled and expensive (Walker and Salt 2006:87), which ultimately leads to diminishing returns on new investments (Tainter (1988:194–99);

2. reliance on artificial, agroecosystems (e.g., terraced field systems) with less biodiversity and with the potential for social formations to get caught in a "risk spiral" because these colonized ecosystems are less resilient and more sensitive to environmental change (Costanza, Graumlich, and Steffen 2007b:14; Dearing et al. 2007:266; Ponting 2007; van der Leeuw 2007:214–15);

3. increasing specialization, efficiency, and optimization, which eliminates redundancies and emphasizes a specific range of values and interests, resulting in a dramatic decline in flexibility, and hence resilience (Walker and Salt 2006:7–8, 85);

4. increasing homogeneity, with the various components of the system being tightly connected (e.g., increased craft specialization, more

causeways linking various components of the community, more administrative nodes and oversight, greater adherence to a specific set of ritual practices), leading to the loss of functional and response diversity and to hypercoherence, both of which diminish the level of resilience in the system (Hegmon et al. 2008; Walker and Salt 2006:164);

5. flexibility giving way to conservatism (Walker and Salt 2006:85–87); and

6. less innovation, with more efforts to continue with existing modes of operation (sunk-cost effect), resulting in greater rigidity (Hegmon et al. 2008; Walker and Salt 2006:87).

Overall, the social system during a K-phase is less flexible, and agents tend to lock themselves into a certain way of doing things. In other words, there is a high degree of path dependency (van der Leeuw 2007:215), which results in brittleness in the face of "unexpected or unpredictable shocks" (see Holling and Gunderson 2002:32–33), of which there were many between AD 750–1050. The droughts documented by the Macal Chasm study would have been particularly significant, "unexpected" shocks with which the increasingly vulnerable communities of the Vaca Plateau would have had to contend with. However, it is important to stress that we still lack sufficient date to determine whether the posited droughts were *meteorological* (based on a decline in normal precipitation over an extended period of time), *hydrological* (reduced stream-flow), *agricultural* (soil water deficiency), *socioeconomic* (when declining water supplies impact the supply of other goods, which in turn negatively impact communities), or a combination of these (Wilhite and Glantz 1985).

In more specific terms, our results support some of the recent observations made by Arlen Miller Rosen (2007), Fekri Hassan (2000), and others (various papers in McIntosh, Tainter, and McIntosh, 2000b), all of whom have underscored that (1) communities react to environmental change based on their own unique cultural traditions and (2) these responses also reflect the fact that communities, and societies at large, are comprised of various subgroups with diverse motivations, differing modes of response, and varying capacities to take action.

In terms of the Vaca Plateau sequences, it is apparent that while climate change did not *determine* the economic, social, political, or ritual responses of the past inhabitants of this area, it could have influenced their responses. These responses also varied over time and space; in general, however, wet periods *often* saw growth (e.g., Caracol, Ixchel, and Minanha), and dry periods *sometimes* led to declines (e.g., Ixchel during the Terminal Preclassic). In an area with a lack of surface water, wetter periods likely offered opportunities that were not normally available. Nevertheless, the relationship between societies and climate change is rarely so straightforward, even in a challenging environment such as the Vaca Plateau. Caracol provides a case in point. Here, projected peak drought times correlate with, or are immediately followed by, periods of strong sociopolitical projects and change directed by the site's elite (i.e., positive reorganization and adaptability). This is reflected in Caracol's architecture, caches, and interments dating to the Late Preclassic and Terminal Preclassic periods. Based on the site's epigraphic record, it is evident in the site's warfare events dating to the onset of the Middle Classic period. It is also evident in the reassertion of the Caracol monumental record at the onset of the Terminal Classic period. Each of these times correlates with a projected period of drought, and each can be categorized archaeologically as a time of prosperity brought on by significant elite leadership and change. Thus, rather than a sociocultural decline brought on by drought, it could be argued that Caracol's response was to build upon adversity positively and from a political standpoint (see also Dahlin and Chase, Chapter 7 in this volume).

Our research also demonstrates that *some* segments of the ancient Maya population were incredibly resilient in the face of a long history of climatic variation, particularly those who were organized through traditional kinship structures and who had long-established ties to improved land and who had perennial springs (Iannone et al. 2009; Iannone and Awe 2010; see also McAnany and Gallareta Negrón 2010:162). In contrast, it is evident that during the Terminal Classic period rulers, as well as the institution of rulership, were *not* as resilient as some members of their support populations (McAnany and Gallareta Negrón 2010:159). Specifically, it appears that the rulers—both great and small—could no longer guarantee prosperity and fertility in the face of population growth, ecological degradation, declining resources, and drought (the impact of the latter was likely exacerbated by the extensive forest clearing that was carried out to create the terraced field systems of Caracol and Minanha [see Griffin et al., Chapter 4 in this volume]). As a result, the crucial role of the ruler in the "sacred covenant" that linked them to primary producers—and the various supernatural powers that controlled the earth, sun, and rain—came into question (Monaghan 1990, 1994, 1995; see also Freidel and Shaw 2000; Iannone and Awe 2010; Joyce 2000; Lucero 2002; Moyes 2006a, 2007, 2008; Moyes et al. 2009). The result of this was likely very similar to what happened to their counterparts in the Colonial era. To quote David

Freidel and Justine Shaw (Freidel and Shaw 2000:277), who follow Ralph Roys (1967:102–3), “Maya rulers of the contact period were held responsible through their conduct and ritual knowledge for the manner in which the weather and crop-related prophecies of the katuns unfolded . . . The consequence of drought and famine for such rulers, in one case, is interrogation for failure of ritual knowledge and evidently sacrifice on posts or scaffolding in a public space.”

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NOTE

1. A cursory examination of the abandonment data for sites in the adjacent subregions reflects a pattern similar to that of the North Vaca Plateau. Xunantunich, located fifteen kilometers to the North of Minanha, exhibits a sequence of emergence, flores-

cence, and decline that is virtually identical to that of Minanha (LeCount et al. 2002). At Pacbitun, cultural remains and the latest radiocarbon date (AD 820–900) indicate that growth and expansion of this site slowed dramatically by Terminal Classic times, followed by eventual abandonment by the tenth century AD (Healy 1990:260). To the East, Caledonia and several other settlements on the banks of the Upper Macal River (Awe 1985; Awe et al. 2005) show considerable growth during the Late Classic, followed by decline and abandonment toward the end of the Terminal Classic period (AD 800–900). At Caracol the Terminal Classic is initially marked by a decline in population with limited and scattered occupation persisting around the site core, followed by subsequent abandonment by AD 900 (Chase and Chase 2007b:23–24).