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Ancient Maya rain water reservoirs in northwestern Belize

Contributions in New World Archaeology 5, 85-99

2013

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ANCIENT MAYA RAIN WATER RESERVOIRS IN NORTHWESTERN BELIZE

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Abstract

The Rio Bravo Conservation and Management Area is a nature reserve in northwestern Belize, which today is overgrown by dense tropical forest. The area is characterized by karst topography. Especially its western part lacks permanent water sources. The region was densely settled by the Maya during the eighth and ninth centuries AD (Late Classic period). Due to the geological conditions, the ancient Maya entirely depended on collecting and storing rain water in order to survive during four months of dry season. This paper briefly summarizes some of the results of my excavations of ancient Maya water features in this region.

Resumen

El "Rio Bravo Conservation and Management Area" es una reserva natural en el noroeste de Belice, que hoy está cubierta por una densa selva tropical. El área se caracteriza por una topografía kárstica. Su lado occidental carece de fuentes de agua permanente. La región fue densamente colonizada por los mayas durante los siglos octavo y noveno d.C. (Clásico Tardío). Debido a las condiciones geológicas, los antiguos mayas dependían completamente de la recolección y almacenamiento de agua de lluvia para sobrevivir durante los cuatro meses de sequía. Este artículo resume brevemente algunos de los resultados de mis excavaciones en los antiguos estanques de agua en esta región.

INTRODUCTION

In the Maya lowlands water is a scarce resource what makes water features important and fascinating research objects (e.g. Adams 1991; Scarborough 1993, 1998, 2003; Lucero 1999, 2006). The investigations reported here took place in the western segment of the Rio Bravo Conservation and Management Area in northwestern Belize, a nature reserve managed by the non-profit organization Programme for Belize (PfB) (Figure 1). The largest site within the reserve is La Milpa (e.g. Hammond and Tourtellot 2003, 2004; Houk and Zaro 2011; Zaro and Houk 2012), followed by Dos Hombres (e.g. Lohse 2004), Maax Na (King and Shaw 2003) and Wari Camp (Levi 2011). These centers as well as many other smaller sites (Scarborough *et al.* 2003; Tourtellot *et al.* 2003) in the area have been investigated under the auspices of the La Milpa Archaeological Project (LaMAP) / Boston University and the Programme for Belize Archaeological Project (PfBAP) / University of Texas at Austin. In the past I have collaborated with both projects.

Figure 1: Rio Bravo Conservation and Management Area, Belize: sites discussed in the text projected onto Google Earth map.

The area under investigation is characterized by karst topography, a scarcity of permanent streams and rivers, and – as a result of the elevated topography – a lack of access to ground water. Annual rainfall today varies between 1400 and 1800 mm per annum with most of the precipitation occurring during the rainy season between June and December (Figure 2). If ancient rainfall patterns were anything like they are today, the ancient Maya had easy access to water for only two thirds of the year when precipitation was abundant. For the remaining three to four months water supply would have been considerably more restricted. The inhabitants of this region depended entirely on the collection and storage of rain water in small and large reservoirs.

Within the densely forested area of the Rio Bravo Conservation and Management Area, as well as in the forested parts of the neighboring Guatemalan Peten and Mexican Campeche there exist various types of depressions that once could have served as water reservoirs. Today, most of these features are permanently dry; others hold water for at least some parts of the year. Among the dry depressions one must distinguish between small depressions and large ones. Small depressions, also called *pozas* (Carr and Hazard 1961: 14) are common landscape features and usually smaller than 900 m^2 in surface

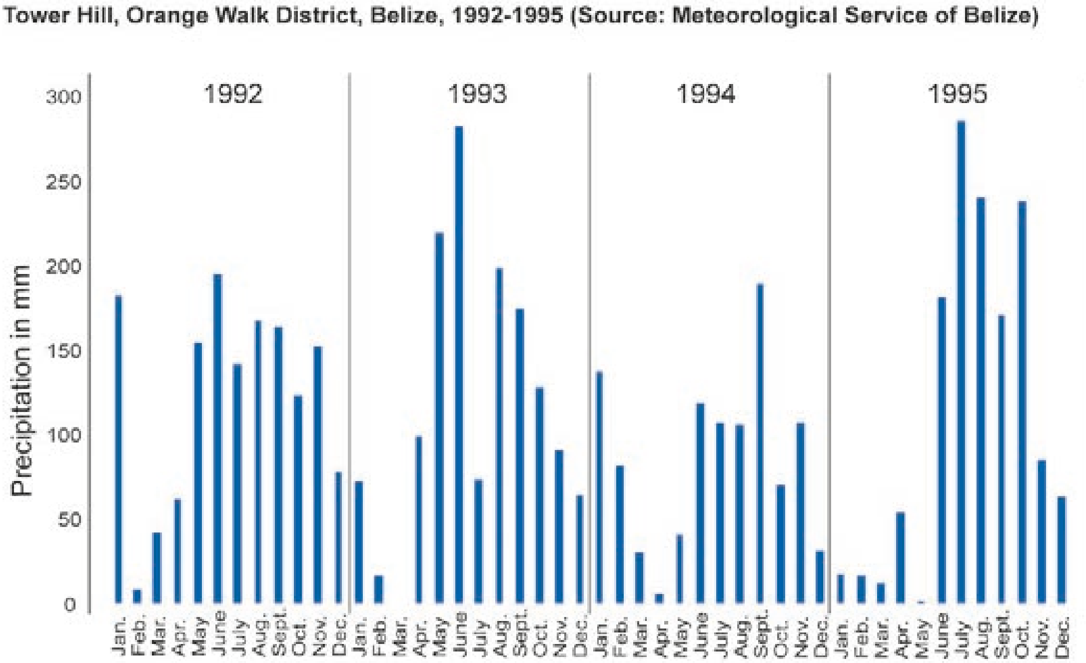

Figure 2: Four-year rain chart from Tower Hill Station, northern Belize 1992 to 1995: annual precipitation 1992 = 1471 mm, 1993 = 1419 mm, 1994 = 1026 mm, and 1995 = 1366 mm. Note the extremely low precipitation between January and May 1995 (only 100 mm). This station usually receives a little less rain than the Rio Bravo Meteorological Station, where rainfall can be as high as 1800 mm per annum.

area (i.e. less than c. 34 m in diameter). They can be found both at ceremonial centers as well as in the hinterland. Small dry depressions not only have been considered potential ancient water reservoirs but also natural karstic sinkholes (*dolines*), the remains of collapsed *chultunob*, rock quarries and clay mines (e.g. Carr and Hazard 1961; Folan 1982; Tourtellot and Rose 1993; Hughbanks 1995; Lene 1997; Weiss-Krejci and Sabbas 2002; Weiss-Krejci 2004).

Large depressions are much rarer and restricted to ceremonial centers. At La Milpa, Tikal, Kinal and other sites they have been considered artificial ancient permanent reservoirs (Scarborough and Gallopin 1991; Scarborough *et al.* 1994, 1995), although this opinion is not shared by everyone. For example, Folan *et al.* (1995) interpret large depressions at the site center of Calakmul as the remains of ancient rock quarries.

Among the depressions that hold water today are *aguadas*, *civales* and *bajos*. Although all three types originated as natural landscape features, they have undergone extensive ancient modifications. *Aguadas* usually range between 500 and 60 000 m^2 in surface area and hold water for most time of the year (e.g. Carr and Hazard 1961; Folan *et al.* 2001: 63; Lohse 2004: 128; Wahl *et al.* 2007). *Civales* are marshes and larger and dryer than *aguadas*. Their vegetation consists predominantly of sedges and grasses and a few species of water-thriving trees. *Bajos* (or *poljes*), which are only inundated for about two months per year, constitute the largest wetland feature. They contain many trees but the canopy is still lower than in the upland forest (Hansen *et al.* 2002). Until the Late Preclassic some of these wetlands (e.g. the Far West Bajo to the northwest of la Milpa), were perennial. Dunning and Beach

(2010: 375) attribute the change from perennial to seasonal wetland to anthropogenic sedimentation associated with deforestation, cultivation, and erosion in the surrounding watershed.

INVESTIGATION OF SMALL DRY DEPRESSIONS

While Scarborough and Dunning, who started their research in the Rio Bravo Conservation and Management Area in the early 1990ies predominantly focused their attention on large central precinct reservoirs at La Milpa (Scarborough *et al.* 1995; Dunning *et al.* 2003), my independent research at first was directed at small dry depressions (Weiss-Krejci and Sabbas 2002). Among the seventeen small depressions that we excavated between 1997 and 2002, I could only identify four as ancient reservoirs (Weiss-Krejci and Sabbas 2002). They range between 81 and 278 m^2 in surface area and between 37 000 and 228 000 liters in capacity. Two depressions are located at Wari Camp (one directly at the site center, the other 250 m to the northwest) and two others at La Milpa East (one in the epicenter of the site, the other one in the hinterland 400 m to the west) (Weiss-Krejci and Sabbas 2002; Weiss-Krejci 2004).

In contrast to Uaxactun, Guatemala or Uxul, Mexico where limestone slabs and large amounts of sherds were used to cover the bottom of ancient water reservoirs (Smith 1950: 61; Grube and Paap 2010; Seefeld, this volume), no such alterations have come to light in northwestern Belize. What distinguishes a dry depression that once served as a reservoir from other types of depressions such as natural sinkholes or ancient quarries is the presence of a hard and gray layer on top of the limestone bedrock (Figure 3). These layers probably are the remains of ancient plaster sealings. Since the limestone bedrock is highly permeable such a modification is necessary to inhibit leakage of

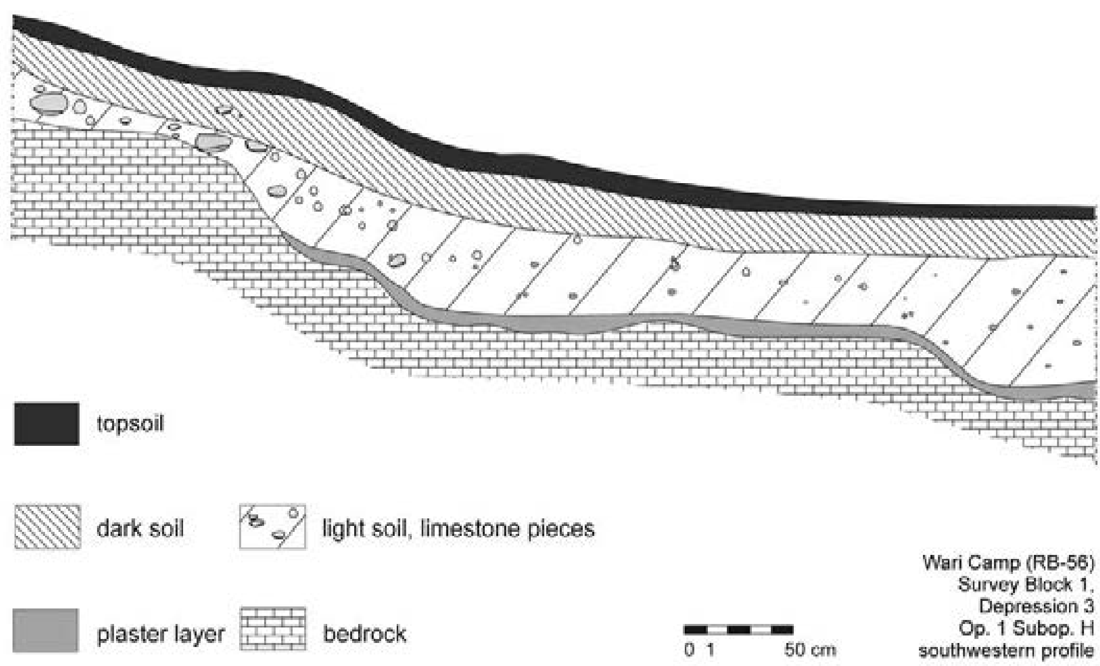

Figure 3: Profile of Depression 3 at Wari Camp Survey Block 1 (Operation 1, Subop. H). A thick plaster layer covers the bedrock.

Figure 4: Late Classic structure in Depression A at La Milpa East. These types of structures were dedicated to the god of wind and rain.

water into the ground. Unfortunately, today the mineralogical composition of these layers is not much different from the underlying bedrock as our analyses of two samples have shown. Additionally no water holding properties can be demonstrated because clay minerals make up less than two percent (see Weiss-Krejci and Sabbas 2002: fn. 8). However, these layers are without doubt artificial – as sherd inclusions prove – and have different physical properties and a different color than the underlying bedrock.

Two of the four identified reservoirs (those two located at the epicenters of La Milpa East and Wari Camp) were filled with sherds and lithic debitage in the later part of the Late Classic (eighth century AD). Hence they were not used as reservoirs any longer. Curiously enough, this modification happened exactly at the time, or shortly after, when the region saw a tremendous population increase. Especially Depression A at La Milpa East has a peculiar use history. The reservoir was first used in the Early Classic – the date is provided by Kerry Sagebiel's ceramic analyses (Sagebiel 2005: 621) – at a time when population density was low. In the seventh century AD the reservoir was abandoned and then filled with gravel and thousands of sherds in the eighth century. According to my calculations around 200 000 sherds weighing between one and three metric tons were thrown in (Weiss-Krejci 2004). This massive in-fill episode must have happened rather rapidly because the lower layers contained large and nicely preserved sherds with sharp edges whereas the upper layers show clear signs of trampling and erosion. Associated with this episode is the construction of an apsidal structure in the northeastern part of the depression (Figure 4). This structure was totally invisible prior to our excavations. Similar buildings have been discovered in the Agua Lluvia Group at Dos Hombres, just 10 m southwest of

Figure 5: Late Classic constructed chert cobble structure at Aguada Lagunita Elusiva (photo by Kasper Hanus).

a small but deep reservoir (Trachman 2007: 225), at the Rosita Group of Blue Creek (Guderjan *et al.* 2010), in the coastal zones of Belize reaching as far south as the Sibun River Valley (Harrison-Buck and McAnany 2006; McAnany 2007; Harrison-Buck 2012) as well as at sites in Guatemala and Mexico. These structures are believed to be temples dedicated to a deity of wind and rain (see also Szymański 2010). The fact that the feature at La Milpa East was associated with a former reservoir provides some support for this hypothesis.

A ritual component associated with this construction episode is further suggested by the ceramics. During her extensive analysis of ceramics from the La Milpa Archaeological Project, Sagebiel came to realize that depressions and especially those located in ceremonial centers such as Depression A at La Milpa East often contain Daylight Orange: Darknight variety sherds as well as many sherds from censers. At and around La Milpa these types of sherds otherwise only occur in temple contexts (Sagebiel 2005: 274).

To the four ancient small reservoirs that I excavated during my research in the Rio Bravo Conservation and Management Area, one must add a few others. One potential small reservoir was investigated at Güijarral by Hughbanks (2006: 233, 251), one at the Medicinal Trail site by Me-Bar (2005) and Brewer (2007), and another – already mentioned above – at the Agua Lluvia group at Dos Hombres by Trachman (2007: 232). The deep reservoir at Dos Hombres, which has a surface area of only 44 m^2 but a capacity of approx. 71 000 liters, was also lined with plaster.

Figure 6: Kasper Hanus (front) and Michael Brandl on their way through the dried out Aguada Misteriosa (May 30, 2011).

AGUADAS AND *CIVALES*

Throughout the Maya lowlands *aguadas* have received scientific attention since the 1980ies (e.g. Domínguez and Folan 1996; Dunning *et al.* 2003; Grube and Paap 2010; Wahl *et al.* 2007; Akpinar *et al.* 2012). At the Programme for Belize several *aguadas* have been the target of scientific investigation. For example, the large La Milpa *aguada* was cored and excavated by Scarborough and Dunning (Scarborough *et al.* 1995: 112). Turtle Pond, an *aguada* associated with the Medicinal Trail site (Scarborough and Valdez 2009: 216–220) has been cored and excavated by Vernon Scarborough and students (Chmilar 2005) and research at Aguada Lagunita Elusiva started in 2003, when it was cored by Dunning. In 2008 I began excavations in this *aguada* (Weiss-Krejci and Brandl 2011) while the surrounding area was investigated by Ezgi Akpinar (Weiss-Krejci *et al.* in prep.).

Aguada Lagunita Elusiva has a diameter of approx. 30 m, a surface area of 615 m^2 and a present-day capacity of 700 000 liters. It usually desiccates during the dry season. Our excavations between 2008 and 2011 revealed that the *aguada* had been heavily modified by the ancient Maya. Michael Brandl, our lithic expert, suspects that it originated as a shallow natural depression full of massive residual chert boulders – this part of north-western Belize still belongs to the chert bearing zone (e.g. Barrett 2004). The boulders were mined by the Maya and used for the fabrication of stone tools. Chert of minor quality as well as plenty of lithic debitage were left behind and later used to construct a cobble platform in the *aguada* (Figure 5). We assume that the platform guaranteed better accessibility

Figure 7: *Cival* K'ante' Ha' and Aguada Misteriosa from space (Google Earth); the horseshoe shaped berm is clearly visible.

to the water during the dry season and possibly also protected the water resource from erosion during heavy rains.

In most of our operations in the northern part of the *aguada*, chert cobbles appeared between five and ten centimeters below the topsoil. A second, deeper and stratigraphically earlier cobble layer was found at a depth of approximately 75 cm. The two cobble construction phases are separated from each other by a 20-40 cm thick natural layer of clay. The remains of a smashed seventh century plate, whose pieces were found embedded into the clay and on top of the lower cobble layer, suggest that the gray clay deposit formed during or after the early Late Classic. The upper layer most likely was constructed in the eight century AD. The lower cobble layer could be seventh century or even earlier. It cannot be directly dated because the ceramics are too eroded. The pollen core taken by Nick Dunning from the *aguada* in 2003 and analyzed by John Jones shows that the *aguada* and its surroundings were already heavily used in the late part of the Early Classic (after AD 400) (Dunning and Beach 2010: 381–382; Weiss-Krejci *et al.* in prep.). The natural *aguada* bottom consisted of a sterile geologic stratum, impermeable to water, identified as bentonite by Walter Postl and Franz Bernhard through XRD and SEM-EDS.

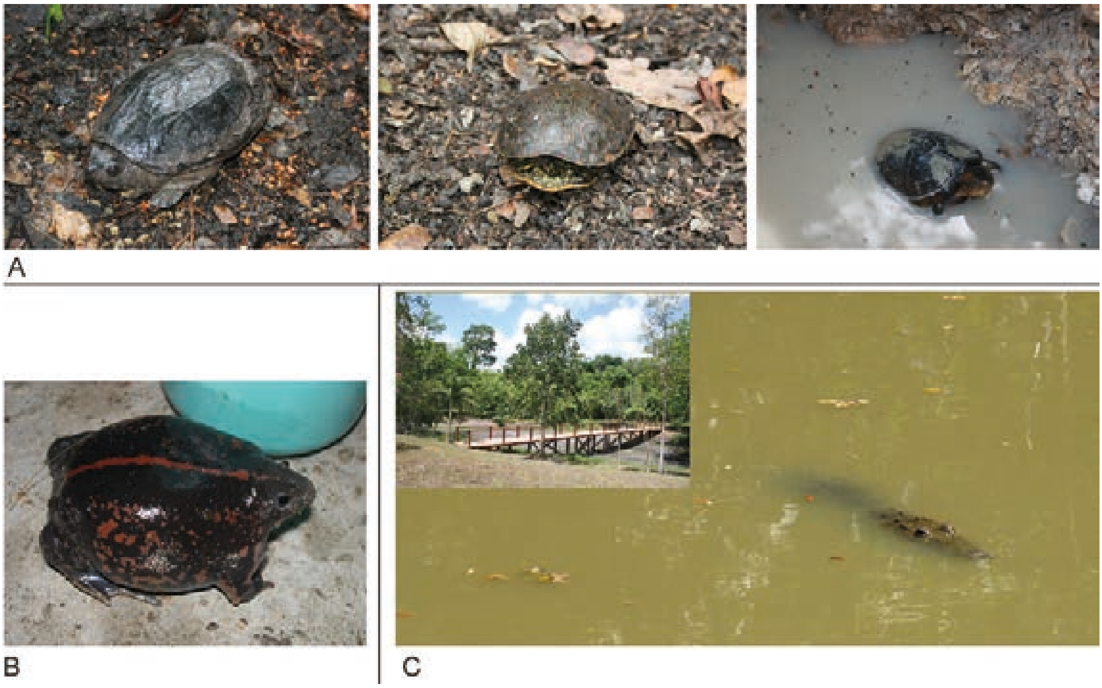

Figure 8: A) Turtles at Aguada Lagunita Elusiva: left: Mexican snapping turtle *Chelydra serpentina rossignoni* (May 29, 2008); center: Honduran slider *Trachemys scripta venusta* (May 22, 2009); right: red-cheeked mud turtle *Kinosternon cruentatum* (June 15, 2010); B) Mexican burrowing toad *Rhinophrynus dorsalis* (May 31, 2008; photo Sarah Kiszter); C) Turtle Pond and one of its inhabitants, a crocodile *Crocodylus moreletii* (March 7, 2011; photo Gerhard Trnka).

About 700 m to the northeast of Aguada Lagunita Elusiva, in 2011 we discovered a large *aguada*, which we named Aguada Misteriosa (Figure 6). Another half kilometer in the same direction (i.e. approx. 6 km east of the La Milpa center), we found a large *cival*. This *cival* received the name K'ante' Ha', which means 'K'an tree water', based on an allspice tree which grew at its southern rim. When the workman cut off a branch, the cross section through the branch revealed a pattern that looks just like the K'an cross (Weiss-Krejci 2012). K'ante' Ha' which covers a surface area of ca. 47 000m^2 is characterized by diverse ecozones and two *aguadas* within its boundaries. One of the *aguadas* within the *cival* is surrounded by a horseshoe-shaped chert cobble berm, which is even visible from space (Figure 7). It measures 100 m in diameter and looks quite similar in shape and dimension to the berm surrounding Aguada Zacatal in Guatemala (Wahl *et al.* 2007: Fig. 2). Unless K'ante' Ha' was navigable by canoe, the inner *aguada* was probably not accessible to the ancient Maya in the rainy season but served as a dry-season reservoir. Excavations within the *cival* have not yet taken place, but are planned for a future field season.

As important as all these reservoirs were for the ancient Maya, they are also of extreme value to the local terrestrial and aquatic fauna. Today, in the dry season the muddy parts of *aguadas* are usually covered with hoof prints and wallowing marks of medium-sized to large mammals (tapir, deer and peccary). When there is but a little water, one can observe a variety of aquatic and semi-aquatic turtles. Some animals only come out at specific times of the year. Just a few hours before tropical storm Arthur

Figure 9: *Chultun* in the epicenter of La Milpa.

hit Belize at the end of May 2008, bringing 217 mm of precipitation and inundating our excavation at Aguada Lagunita Elusiva, we observed a Mexican snapping turtle *Chelydra serpentina rossignon* leaving the reservoir (Figure 8a). The frog *Rhinophrynus dorsalis* (Figure 8b) usually only emerges after heavy rains. Its loud mating call 'wh-o-o-o-a' can be heard for days throughout the jungle. And the local crocodile (*Crocodylus moreletii*) also only shows up when there is enough water. One small specimen has been living at Turtle Pond for several years but is never visible when the *aguada* is dry (Figure 8c). These animals and especially their association with rain and water must have made a deep impression on the Maya.

CONCLUDING REMARKS

Estimates for Classic Maya population density within the region under consideration range between ca. 500 and 800 people per km^2 in the eighth century AD (e.g. Scarborough *et al.* 1995; Tourtellot *et al.* 1996; Hageman and Lohse 2003). The peak population of La Milpa alone is estimated to have reached approximately 46 000 people. How so many Maya comfortably lived under such fragile climatic conditions remains one of the big puzzles to be solved. Apart from artificial reservoirs and modified *aguadas* it is probable that some of the *chultunob*, which are so frequent in this area (Figure 9), also served water storage function (e.g. Scarborough *et al.* 1995: 109). However, high population density in northwestern Belize did not persist. In the ninth century AD, or possibly one century later, the Maya left the area (Hammond and Tourtellot 2004; Zaro and Houk 2012). Their exodus is partially reflected in Dunning's pollen core from Aguada Lagunita Elusiva. It shows that, following a dramatic decrease in cultigens and a large spike in fern spores, by AD 900, the *aguada* was completely abandoned and recolonized by upland forest (Dunning and Beach 2010: Fig. 23.7). It has been suggested by some researchers (e.g. Curtis *et al.* 1996; Hodell *et al.* 1995, 2001; Lucero *et al.* 2011) that this demise of Maya civilization was the result of an increasingly drier climate – its effects were already felt in the latter part of the eight century AD in other areas of the Maya lowlands. Considering the complex water situation such an interpretation is plausible.

ACKNOWLEDGEMENTS:

The field operations reported here took place under a permit from the Belize Institute of Archaeology to Fred Valdez, Jr., the Director of the Programme for Belize Archaeological Project. My 2007 to 2011 investigations continue the work of Boston University's La Milpa Archaeological Project (LaMAP), directed by Norman Hammond and Gair Tourtellot, and in 2009 and 2010 were partly funded by a Sackler Scholarship from funds granted to Norman Hammond. I also would like to thank Hermann J. Hendrich for his financial support during the 2011 season. The Austrian Science fund FWF funded research in 1997 and 1998 (Projects P12256 and P12953). I would like to thank Michael Brandl for his analysis of chert and invaluable help in the field, Kerry Sagebiel and Lauren Sullivan for conducting ceramic analyses, Nick Dunning and Ezgi Akpinar for their collaboration concerning Aguada Lagunita Elusiva, Walter Postl for XRD analysis and Franz Bernhard for the SEM-EDS. Thanks are due to all the students who have collaborated over the years, all of my Belizean workmen and of course, the organizers of the 2nd Cracow Maya conference.

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