Manantial de la Aleta – the top of the iceberg in Caribbean cave

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Abstract

Manantial de la Aleta is the name of cenote, a limestone sinkhole located in the south of La Altagracia Province (Fig. 1), in the easternmost part of Dominican Republic, on the island of Hispaniola (Haiti).[1] Between 1996–1999, researchers from Indiana University and California State Parks conducted a survey of the cenote in collaboration with the Museo del Hombre Dominicano and the Oficina Nacional del Patrimonio Cultural Subaquatico, which resulted in the excavation of over 200 artifacts and the recorded location of many more. However, the considerable depth of the cenote (73 m), must have severely limited the researchers' capabilities – the top of the talus is at a depth of ~34 m, as was the time they could spend at the working depth. It is not difficult to conclude that this work, despite its rich results, has only provided a picture of the top of the iceberg, and that Manantial de la Aleta definitely requires a more thorough investigation in deeper parts, not only because of the numerous Taíno cultural artifacts recorded, but also because of the cenote's potential in relation to the oldest culture discovered on Hispaniola, the Casimiroid, representing the first wave of human migration in the Antilles, traces of which have been recorded in other surrounding caves. Sinkholes of this type in Central America are also usually rich in palaeobiological material, as confirmed by numerous discoveries at Yucatán peninsula.

Key words:

underwater cave archaeology, cave diving, technical diving, Central America, Taíno, Casimiroid.

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[1] The original inhabitants called their island *Ayiti* (Keegan and Carlson 2008: 42,43). Today there are two states there: Haiti and the Dominican Republic. The descendants of Polish legionnaires who remained on the island after Napoleon Bonaparte's 1802 campaign live there.

Manantial de la Aleta – site description and meaning

Fig. 1 – Cenote Manantial de la Aleta, Dominican Republic, Hispaniola (Haiti) at the area of Parque Nacional Cotubanama, also known as Parque Nacional del Este.

Cenote Manantial de la Aleta[2] (La Altagracia, Dominican Republic, Hispaniola) is a ritual and sacrificial site for the Taíno people.[3] Although no human remains have been found there to date, this is evidenced by the amount of richly decorated pottery found there, in addition to utilitarian vessels, also with food remains and other rare artifacts such as shafts

[2] The name Manantial de la Aleta is contemporary and means the cave of the fin. It was named after a shed with a thatched roof resembling a fish's fin (Conrad *et al.* 1997: 60).

[3] Taíno is the generic name for the peoples inhabiting the Bahamas (Lucayan Archipelago), the Greater Antilles and the northern part of the Lesser Antilles. The term Taíno was first coined by Constantine Samuel Rafinesque in 1836, the Taínos never called themselves this way, nor is it a precise ethnic identification (for example, we know that the Lucayan Taíno came from the Orinoco River in present-day Venezuela). Until the 1980s, these peoples were called Islands Arawaks because they spoke languages from the Arawak group found in South America. Today, in order not to confuse the culture from the islands with that from the mainland, we refer to them as Taíno (Oliver 2009: 6–7,27–30). The Taíno were the first to be encountered by Europeans and had the privilege of making their cultural mark linguistically: *huracan*, *hamaca*, *barbacoa*, *cacique*, *canoe*, *piragua*, *higuana*, *manati*, *baracutey*, *sabana*, *henequen*, *guacamaya*, *mahiz*, *tobaco*, *yuca*, *anana*, *guayaba*, *mamey*, *papaya*, *guanabana*, *chicha* or… *Canibale* are Taíno words (Keegan and Carlson 2008: 1–3,7–8,10,11–12,31,32,36,37,43,48,54,67,72,78,82,84,89,105–110; de Oviedo y Valdez after: Baraibar [ed.] 2010: 267–272) Taíno people themselves were exterminated by Spaniards during one generation (Conrad *et al.* 1997: 60) however some scholars claims they in some way biologically and culturally survived (Ferbel-Azcarate and Carpinelli 2003).

and axe heads, and above all *duho*[4] thrones, associated with the royal power of the *caciques*. Geoffrey W. Conrad *et alia* (2001: 3, Figure 5; 2003: 706–707), Conrad *et alia* (2005: 9,13, Figure 6), Charles Beeker *et alia* (2002: 1,20) and John W. Foster and Beeker (1997: 31) emphasise that the Manantial de la Aleta, in whose vicinity four ceremonial plazas were exposed, must have had the same function as cenotes in Mesoamerica and served the Taíno to maintain contact with their ancestors, passing away after death to *Coaybay* – the House of the Dead.[5] The portals in the form of a water mirror in the caves were bidirectional, and spirits of the ancestors – the *opias* – were returning to the world at night in the form of bats. The Taíno ancestors also emerged from a cave called *Cacibajagua*, the Sun and Moon emerged from a cave called *Iguanaboina*, and their world, as in Mesoamerica, was divided into three layers connected by a common *axis mundi* in the form of a giant tree (Ramon Pané [1497–1498] *Relación Acerca de las Antigüedades de los Indios…*, after: Arrom [ed.] 2001: 22–23,31,32; Morton 2015: 9–10). While the role of cenotes and caves in general as portals to the supernatural world for the Mesoamerican cultural area and the Maya civilization in particular is already quite well described (Brady and Ashmore 1999; Brady and Prüfer 2005, Houston *et al.* 2006; Kieffer and Scott 2012; Prüfer and Brady 2005, Taube 2004; 2010; Trześniowski 2018), the occurrence of similar beliefs in the borderlands and beyond Mesoamerica is not well understood and certainly deserves the appropriate attention.

Manantial de la Aleta is located in a Pleistocene karst area, which means that the terrain is very thick, with a small number of surface sources of drinking water and numerous passages to the aquifer hidden under the rocks in the form of caves, cracks and solution cavities. The area is densely covered with tropical vegetation. The first description of the cenote was given by Bartolome de las Casas in *Apologetica Historia de las Indias* (1909: 10–11), who was present at the conquest of Higüey province in A.D. 1503 and noted that it was the only reliable source of drinking water within a radius of many kilometres. He described how water was obtained from the cenote by the local Taíno, as well as the fact that salt water was found in the cenote at greater depths. Manantial de la Aleta is located within 5 km of the

[4] *Duho* – ceremonial seats, usually in the form of an anthropo/zoomorphic creature on all fours, its 'tail' sometimes extending into a high back were used during important ceremonies distincting their high-ranking owners from the common people (Ostapkowicz 1997: 56; 2015: 63–65; Ostapkowicz *et al.* 2013: 4675–4676).

[5] Conrad *et alia* (2003: 707) Beeker *et alia* (2002: 3–4,20) and Matthew J. Maus *et alia* (2017: 215,216) 216) also draw attention to the potential symbolism of the cenote as a source of water associated with the *zemi* Atabey, or Attabeira, the Taíno supreme goddess, Mother of Waters and force of female fertility, and to the possibility that Manantial de la Aleta was seen by the Taíno as one of the eyes of the animated island of Hispaniola, whose head was just to the east of the island. All three interpretations presented are not, in their view, mutually exclusive.

Caribbean Sea coast (Beeker *et al.* 2002: 8–9; Conrad *et al.* 2001: 1–2,Figure 1; Conrad *et al.* 2005: 7,9; Foster and Beeker 1997: 27; Maus *et al.* 2017: 201).

Seven small, closely spaced openings lead into the Manantial de la Aleta cenote, the largest of which measures about 2 by 3 m. The water surface in the cenote is about 15.5 m below.[6] At a depth of about 10.5–11 m below the water table, a dense layer of hydrogen sulphide starts to appear – a phenomenon typical of foibas, well-shaped cenotes without a constant flow of water, i.e. cut off from the any larger cave system.[7] Beginning from this depth, the water is deprived of oxygen. The chemocline at Manantial de la Aleta is approximately 9 m thick (Fig. 2). Below, from a depth of about 20 m, the water is clear again. The cenote is bell-shaped with dimensions of approximately 40 m on the north-south axis by 42 m on the east-west axis, at the height of the water table. It extends sideways and descends to a depth of at least 73 m. In the centre of the cenote there is a huge talus – a cone of material from a torn off vault and organic matter, which over thousands of years fell into the cenote through holes in the vault. The top of the talus, located at a depth of about 34–36 m, is topped by a rock over 6 m in diameter. The temperature throughout the water column is 24.2 ˚C (Beeker *et al.* 2002: 8–9; Conrad *et al.* 2001: 2–3, Figure 2; Conrad *et al*. 2005: 10–11; Foster and Beeker 1997: 27–29, Maus *et al.* 2017: 207–209).

While the terrestrial site, consisting among other things of a ceremonial plaza, was reported by Jose Guerrero as early as (1981: 14–15), it was only the artifacts excavated by local divers from the Manantial de la Aleta cenote, situated 75 m south of the plaza, that drew the attention of the management of the Parque Nacional del Este (East National Park) to its rich archaeological potential.[8] Preliminary underwater investigations were carried out there between 1996 and 1999. Later, three more ceremonial plazas – *bateyes* were found (Beeker *et al.* 2002: 9–10; Conrad *et al.* 1997: 60; Conrad *et al.* 2001: 2; Conrad *et al.* 2003: 706; Conrad *et al.* 2005: 8–9,11,21–22,29; Foster and Beeker 1997: 27,30; Maus *et al.* 2017: 209).

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[6] The field study authors have reported here depths of 15.5 m to the water table and 10.5 m to the hydrogen sulphide (Conrad *et al*. 2005: 10) or 50 and 65 feet respectively (Forster and Beeker 1997: 27). Beeker *et alia* (2002: 8–9) round off the water table depth to 16 m and the hydrogen sulphide layer depth to 10 m. As these values do not correspond to within about 0.5 m in the text these depths are taken with the prefix about or approximately. The same is true for the remaining values, which vary slightly from publication to publication. The greatest discrepancies occur in the reported depth of the top of the talus: 34 m (Beeker *et al.* 2002: 9), 34,5 m (Conrad *et al.* 2003: 705) *vs.* 36 m (Maus *et al.* 2017: 208).

[7] Author's own observation (Trześniowski 2018: 32), made on the basis of a similar construction of cenotes, such as Cenote Angelita (Tulum, Meksyk), Cenote Zapote (Puerto Morelos, Meksyk), Cenote Sabac Ha (Sacalum, Meksyk) or Pool 1 (Cara Blanca, Belize).

[8] Among other things, local divers have extracted two axe handles that have been dated to 800 ± years BP (Forster and Beeker 1997: 30).

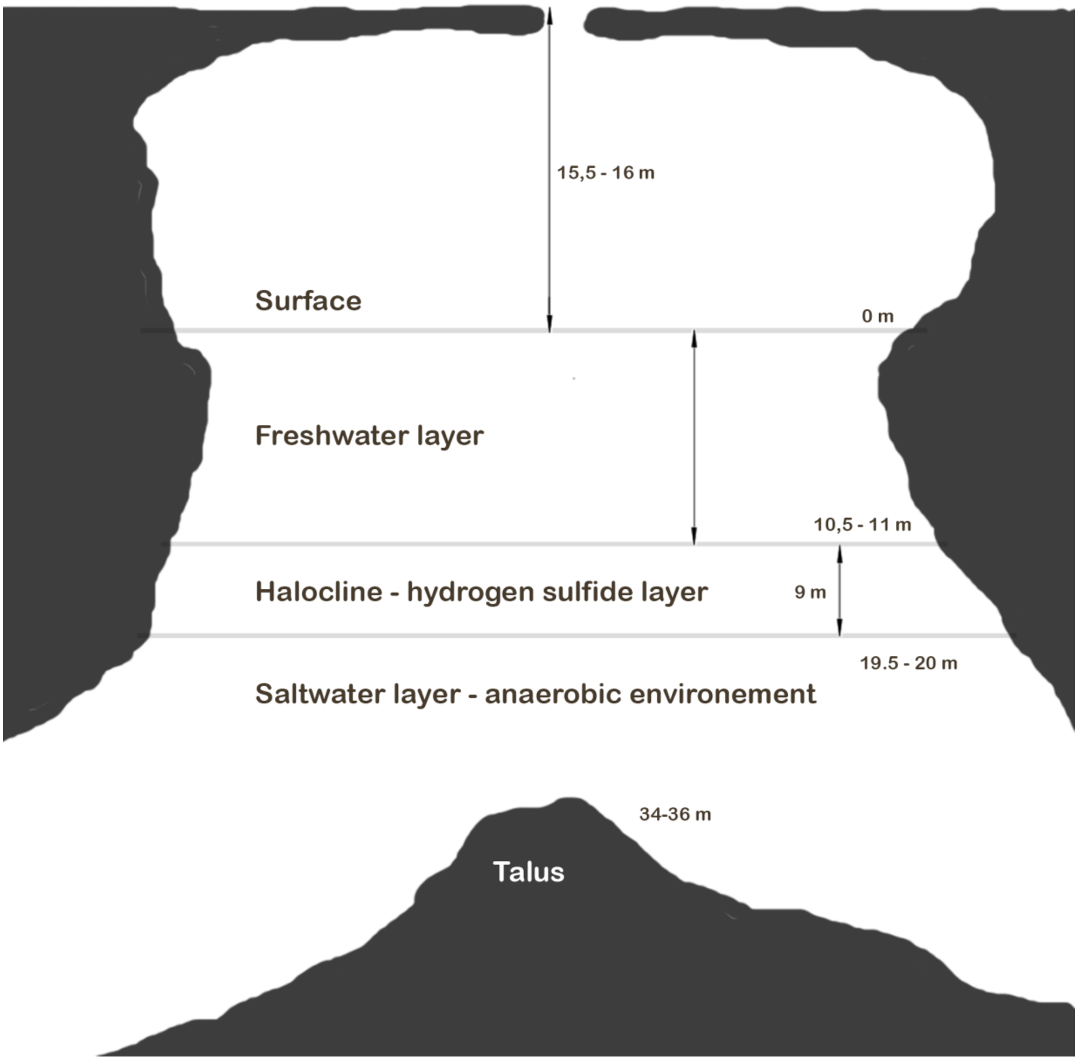

Fig. 2 – Manantial de la Aleta vertical cross section, basing on (Beeker *et al.* 2002: 8–9, Figure 10; Conrad *et al.* 2001: 2–3, Figure 2; Conrad *et al*. 2005: 10–11, Figura No.3; Foster and Beeker 1997: 27–29, Figure 2; Maus *et al.* 2017: 207–209, Figure 11.1).

Project results from the 1990's.

Already George Bass, one of the forefathers of underwater archaeology, pointed out the good state of preservation of artifacts underwater, usually impossible to get at terrestrial sites (Bass 2008: 11–66). In Mesoamerican caves we find well-preserved fragments of textiles, shell and wood artifacts. In flooded caves in the Yucatán we find prehistoric skeletons of humans and extinct fauna from the Pleistocene – such finds are absent from terrestrial sites there. The results achieved during the preliminary studies of the Manantial de la Aleta cenote between 1996 and 1999 were also a huge surprise for the researchers.

The underwater prospecting methods applied between 1996 and 1999 at Manantial de la Aleta were three-dimensional mapping against a datum located on top of the talus, filming and photography and limited test excavation (two operations). All visible artifacts were mapped relative to the datum. The mapping was then completed using a grid constructed from PVC pipes (Foster and Beeker 1997: 28–29; Maus *et al.* 2017: 209–210).

Not surprisingly, the largest accumulation of artifacts in the cenote was encountered near the top of the talus, below the largest of the openings in the cave ceiling – fragments of more or less broken pottery, mainly water vessels, but also vessels of probably ceremonial character. Numerous other artifacts of wood, basketry and stone were found in the close vicinity of the summit, partly buried in the soft sediment (Foster and Beeker 1997: 29; Maus *et al.* 2017: 209).

Ceramic artifacts

A total of 191 ceramic objects have been recovered from Manantial de la Aleta, of which 27 are complete or nearly complete vessels and a further 53 are fragments of at least half vessel size. Most of the excavated ceramic fragments belong to the Chican Ostionid (Chicoid) subseries,[9] from the Classical Age of the Taíno chiefdoms on Hispaniola, but two were classified as predating the Taíno types of the Huecoid, or Huecan Saladoid (Conrad *et al.* 2003: 705). All vessels are blackened from the dark humus of the cenote. The bowls resemble vessels known from surrounding sites in the Higüey region,[10] but are much more richly decorated than, for example, those from the typically utilitarian Cenote Chicho in the Padre Nuestro complex, 20 km away.[11] The most frequently recurring motif on ceramic from

[9] Chican Ostionoid period A.D. 1200–1500 (Curet 1996: 114,119–121).

[10] Manantial de la Aleta is located within the former chiefdom of Higüey. At the time of the arrival of the Spaniards, Hispaniola was divided into five such chiefdoms – *cacicazgos* (Maus *et al.* 2011: 201).

[11] There was also found one intact *potiza* – decorated bottle at the depth of 8 m however there, as well as set of petroglyphs close to an entrance of the cave (Foster *et al.* 2005).

Manantial de la Aleta is the head of a bat.[12] Other ornaments include the eyes of an owl in the case of one of the vessels, a creature with similar associations with the hereafter as bats; a modelled frog, associated in Taíno mythology with water and fertility in the case of another; and a turtle in the case of yet another, a creature associated with female fertility. One of the vessels bears traces of gluing with resin, which has continued to hold despite the passing years. The vessels show no signs of wear, which suggests that they were made specifically for ceremonial purposes. One of the vessels contained numerous guácima (*Guazuma ulmifolia*) seeds (Beeker *et al.* 2002: 12–19, Figures: 15–25; Foster and Beeker 1997: 29, Maus *et al.* 2017: 210; Morton 2015: 10). A pioneering for that time study by Instrumental Neutron Activation Analysis (INAA) of 175 ceramic fragments from four sites in the vicinity of Manantial de la Aleta, the cenote itself and the Cangrejera sites on the coast, west of Manantial de la Aleta and Punta Macao on the rather remote northern coast of Hispaniola allow them to be divided into five different sites of origin, which supports the thesis of the regional importance of Manantial de la Aleta, as does a single intact vessel, unique to Manantial de la Aleta, and similar to a vessel from Cueva de Roma on the north coast of Hispaniola, outside of the Higüey region (Beeker *et al.* 2002: 19; Conrad *et al.* 2007; Conrad *et al.* 2008; Maus *et al.* 2017: 210–211).

Wooden artifacts.

Twenty-one wooden artifacts were recovered from Manantial de la Aleta, including one complete and one partially burned *duho* – a ceremonial throne used by Taíno caciques in public ceremonies (Ostapkowicz 1998: 135–392,551–569). Such thrones are very rarely found in the Dominican Republic in archaeological contexts – wooden artifacts are very rarely preserved on limestone substrates, as they are on the Yucatán Peninsula. This throne was located at a depth of approximately 34 m.[13] A wooden *macana*[14] mace 79 cm long and 5 cm in diameter, made of a palm wood, was recovered from a depth of about 38 m. This is

[12] According to Taíno beliefs, the *opias* – spirits of the dead – flew out of caves at night in the form of bats to feed on guava fruit (Pané after: Arrom 2001: 33), which may link vessels decorated in this way to ancestor worship.

[13] If one assumes a depth of 36 m at the top of the talus, as reported by Maus *et alia* (2017: 208) then the place would have been floating in the water…

[14] The description of this weapon comes from the chronicle of Gonzalo Fernández de Oviedo y Valdez *Historia General y Natural de las Indias…*, after: Baraibar [ed.] 2010: 112–113; (Ostapkowicz 1998: 126–127).

probably the only such surviving and documented specimen. In addition, a small oval vase, probably used in *cohoba*[15] ceremonies, a ceremonial spatula for stimulating vomiting, 19.5 cm long, six wooden bowls of round or oval shape, 12–30 cm in diameter and with a wall thickness of 0.8 to 1.5 cm (two of them decorated), an oar fragment, a crocodile figurine 20 cm long, which may have represented *zemi*,[16] three large axe handles, 36–63 cm in size, two of which have holes for head seating made through, the third with a hole perhaps unfinished – two handles have modest decoration in the form of a small protrusion in the central part, one small curved handle, 22 cm long – without any analogues in the Taíno artifact collections, four more artifact fragments of unknown purpose (Beeker *et al.* 2002: 10–12; Conrad *et al.* 2001: 5–12; Conrad *et al.* 2003: 705–706; Conrad *et al.* 2005: 12–28; Foster and Beeker 1997: 30; Maus *et al.* 2017: 211).

Other organic artifacts

At Manantial de la Aleta, a considerable accumulation of *higueros* – well-preserved calabash (*Crescentia cujete*) vessels – was found, which were retained by a tree trunk lying at a depth of about 50 m, on the south-western slope of the talus and acting as a natural dam there. Fragments of a calabash vessel, bearing traces of carving and polishing in the Chician Ostonoid style, were recovered from the test pit at a depth of about 38 m. This calabash vessel also had holes along the edge that may have been used for hanging it. A few well-preserved wicker baskets were also observed, but when one of these was recovered it quickly deteriorated, so the remaining wicker artifacts were left *in situ* (Conrad *et al.* 2001: 12–14; Conrad *et al.* 2003: 705–706; Conrad *et al.* 2005: 12, Figure 27; Foster and Beeker 1997: 30; Maus *et al.* 2017: 211).

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[15] Purification ceremony and contact with the supernatural world, made possible through the use of a hallucinogenic substance made from the seeds of the *Anadenanthera peregrina* – cohóbana tree (Oliver 2009: 14; Ostapkowicz 1997:56; Ostapkowicz *et al.* 2013: 4675,4680; Pané after: Arrom 2001: 30,35,41–42,69,109,112–113,117).

[16] *Zemi* or *cemí* according to a 15th century Taíno myths from Hispaniola were animating forces that would embody trees at will, making their branches or even roots move with the power to speak and demand they to be carved in a certain way. Next, during *cohoba* ceremonies they revealed their names, and so their powers. These carvings were therefore tangible embodiments of a greater connective whole, linking supernatural beings directly to humans' actions; also spirits of ancestors or deities (Oliver 2008: 174–201; 2009; Ostapkowicz 1998: 433–434; 2018: 3; Ostapkowicz *et al.* 2013:4676; Pané after: Arrom 2001: 41–46).

Lithic artifacts

A fragment of an axe head, probably made of serpentine, was also recovered from Manantial de la Aleta. Fourteen other axe-heads, two stone balls, as well as several axe handles were retrieved by local divers in the years preceding the survey (Conrad *et al.* 2001: 12, Figures: 17,18,19; Conrad *et al.* 2003: 706; Foster and Beeker 1997: 30–31).

Summary of research activities 1996–1999

A total of 244 artifacts[17] were recovered from the Manantial de la Aleta between 1996 and 1999, the vast majority of which were ceramics and lithics. Out of concern for preservation, most of the artifacts made of organic materials were left *in situ*, extracting only 24 of them. The outstanding state of preservation of organic artifacts at Manantial de la Aleta is due to the anoxic environment that prevails in the cenote from a depth of about 10.5–11 m (Beeker *et al.* 2002: 10; Conrad *et al.* 2001: 3; Conrad *et al.* 2005: 12, Maus *et al.* 2017: 211).

Artifacts made of organic materials at Manantial de la Aleta were dated AMS to A.D. 1035–1420, which places them in the time of the rise and the prosperity of the Taíno chiefdoms (Beeker *et al.* 2002: 10; Conrad *et al.* 1997: 61; Conrad *et al.* 2001: 14–15, Table 1, Conrad *et al.* 2003: 706; Foster *et al.* 2005: 1–2).[18]

Beeker *et alia* (2002: 10,19–21), Conrad *et alia* (2001: 3), Conrad *et alia* (2003: 705,706) and Maus *et alia* (2017: 209,213) point out that the condition and types of artifacts found in the cenote indicate that they were deposited intentionally, not abandoned as rubbish. Quite a lot of the pottery is whole, while the large size of the fragments of the others indicates that they became broken as they sank to the bottom. *Duho* thrones, a *cohoba* bowl or a spatula to stimulate vomiting are ceremonial paraphernalia, while weapons such as mace and axes may have symbolised the high status of the possessor in Taíno culture.[19] All in all, these artifacts probably represented sacrifices to ancestral spirits, and the moment they disappeared

[17] Beeker *et alia* (2002:9) mention about 245 artifacts, Conrad *et alia* (2001: 3) or Conrad *et alia* (2005: 12) about 244, Maus *et alia* (2017: 210) safely about more than two hundred…
[18] Maus *et alia* (2017: 211) give dates of A.D. 1058–1392.
[19] Ostapkowicz (1998: 126).

in a cloud of thick hydrogen sulphide was the instant they passed into the otherworld through a mythical veil.

Technical aspects

None of the publications to date detail the technical aspects of the underwater prospection conducted at Manantial de la Aleta between 1996 and 1999, published photographs such as in Conrad *et alia* (2001: Figure 4), Conrad *et alia* (2005: Figure 5) Maus *et alia* (2017: Figure 11.15) or the video document *Underwater Archaeology at Manantial de la Aleta* published on John Foster's youtube channel suggest, however, the use of a simple single cylinder configuration and, consequently, the use of only breathing mixtures available for recreational diving, such as air and enriched air nitrox (EAN 22–40). While this latter conclusion is an obvious presumption on the part of the author, it nevertheless allows one to reason about the limitations of the time and depth at which any design work could therefore be carried out.

Conrad *et alia* (2001: 3,15), Conrad *et alia* (2005: 11) and Maus *et alia* (2017: 209) admit that the underwater investigations carried out between 1996 and 1999 took the form of controlled surface collections of spotted archaeological artifacts rather than real excavations: *"The investigations took the form of controlled surface collections rather than excavations; selected artifacts were mapped in three dimensions and then brought to the surface"* and postulate the need for further and more systematic research of the site. They also mention thousands of organic artifacts, mapped and left *in situ* with the aim of better preservation (Maus *et al.* 2017: 210). Published maps of the site (Conrad *et al.* 2001: Figure 3; Conrad *et al.* 2005: Figure 4; Foster and Beeker 1997: Figure 3; Maus *et al.* 2017: Figure 11.13) show instead, unfortunately, only a few dozen positions (PNE-01-104-203).

Published maps of the site (Conrad *et al.* 2001: Figure 3; Conrad *et al.* 2005: Figure 4; Foster and Beeker 1997: Figure 3; Maus *et al.* Figure 11.13) show that mainly the top of the talus was surveyed – clearly as remaining within the researchers' best reach, being at a depth of some 34.5–36 m. Clearly this is the place that may have collected the greatest number of items but the researchers themselves pointed out that many of the artifacts rolled down the steep slopes of the talus, i.e. most of the *higueros* they spotted, organic vessels made of calabash, were retained by the trunk of a tree lying at a much greater depth of about 50 m across the slope (Conrad *et al.* 2001: Figure 3). It seems logical to conclude that the greatest accumulation of vessels and other round objects should rest near the bottom of the cenote, at the depths exceeding 70 m.

Research publications mention test pits made at depths of 115 ft and 125 ft, corresponding to approximately 35 m and 38 m (Foster and Beeker 1997: 30, Figure 3). According to commonly used US Navy dive tables,[20] using air as the breathing gas, the no-decompression time allowed at a depth of 38 m is approximately 11 minutes.[21] The publications do not mention which dive tables were used to plan the dives during the survey work at Manantial de la Aleta, but this is an approximate value to illuminate the problem. The time window of even several minutes more available for work during a single dive is in any case not much. Although Beeker *et alia* (2002: 9) mention the undertaking of 245 artifacts from the slopes of the cone at the depths ranging from 40 to 71 m,[22] even if one assumes the feasibility of similarly risky dives with a single cylinder and air as a breathing factor to collect objects from the surface of the cone, it is difficult to assume the possibility of any serious project fieldwork being carried out this way.

Among the pottery fragments two *pre*-Taíno were found (Conrad *et al.* 2003: 705), which allows us to conclude a ceremonial or utilitarian use of the cenote also in the period preceding the Taíno culture – the older material should rest in the deeper layers of the cone debris. Researchers also note the absence of hunting and fishing objects (Maus *et al.* 2017: 214–215) however, the sample of artifacts recovered so far from the Manantial de la Aleta cenote for the Taíno culture itself may as well not be representative, and only a thorough examination of the cenote as a whole will allow conclusions on this subject to be made with a clear conscience.

A thorough examination of the cenote would require the opening of many deeper test pits at different depths to check the deeper parts, which would entail the use of breathing mixtures, allowing much longer operation at the required depths, and possibly closed circuit rebreathers (CCRs).

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[20] 2016 U.S. Navy Diving Manual, Revision 7, Washington.

[21] Due to the risk of decompression sickness (DCS) in the event of equipment failure and the need to ascend directly to the surface, diving requiring decompression stops with a single cylinder is considered highly dangerous.

[22] Conrad *et alia* (1997:61) mention depths 115-240 which means about ~35-73 m, Foster *et alia* (2005) mention depths range of 36-54 m.

Methodological aspects

The methodological limits of underwater archaeology in the 1990s were due, among other things, to technical limitations: the equipment configuration used and the training methods. A diver who cannot hover in place without movement is unable to take the photographs for stereo-photogrammetry, without visibility being compromised by sediment being lifted from the bottom by fins. Also, the amount of time researchers could spend on the site at working depth, with inevitable effects of inert gases narcosis, further limited the available range of survey methods to only search and rescue of the artifacts and mapping only the accessible part of the site, making more wide underwater excavations unfeasible.

The limitations of conservation methods for objects made of organic matter were also not insignificant. As John Foster mentioned (personal communication 2021) "*After 2 seasons at Manantial de La Aleta it was decided not to recover more organic materials from the archaeological deposit because conservation efforts were not very effective. Wood, basketry and gourds did not conserve very well with the PEG treatment prescribed by conservation experts*".

Performing a spatial analysis of deposited artifacts could yield information on the possible variability of the rituals over time. All the artifacts deposited on the surface of the talus should have been recorded using photogrammetry and only then removed, revealing further, older deposits. More detailed photogrammetry of each of the objects undertaken could also be accomplished underwater, without the need to endanger the unique artifacts by pulling them out to the surface from the anoxic environment in which they remain so well preserved to this day. Apart from taking the samples necessary for radiocarbon dating, there is no need to remove the artifacts from the cenote; they can remain in their current environment once the research is complete. A similar approach has worked well in more methodologically advanced underwater archaeological projects, such as Cenote Holtun (García Sedano 2014: 31–43) or Hoyo Negro (Chatters *et al.* 2017: 120–122).

Why should we return to Manantial de la Aleta?

Maus *et alia* (2017: 201,215–216) point out that the area of Parque Nacional del Este in the southern part of the province of La Altagracia (Dominican Republic, Hispaniola) is dotted with hundreds of caves, both dry and submerged, and although many caves are generally reported along and across Hispaniola only a few, such as Cueva de Berna or Cueva Maria Sosá have been reliably documented despite being important windows into the prehistory of the island and the Caribbean archipelago. Many other caves remain undiscovered or unsurveyed to this day. However, the Manatial de la Aleta remains the most important one, both on the scale of Hispaniola and the Caribbean, and a thorough archaeological survey has not yet been carried out there.

The potential of Taíno culture

As was mentioned earlier, caves were a very important element in the life, cosmology and cultural-religious landscape of the Taíno. Caves were burial sites, ritual sites, places of ritual rock art in the form of pictographs and petroglyphs and, finally, places from which the water necessary for life was drawn, in a more or less ritualised manner, as in the Maya area. Manantial de la Aleta is to date the only cave in the region with an explicit ceremonial purpose as an offering site. It is the most important sacrificial-ceremonial site of its kind in the Caribbean (Beeker *et al.* 2002: 1–5,19–21; Conrad *et al.* 2001: 3, Figure 5; Conrad *et al.* 2003: 706–708; Maus *et al.* 2017: 201–202,215–216; Morton 2015; Pané after: Arrom 2001: 22–23,31,32), so its thorough study is crucial for a broader understanding of the material culture and religious views of the Taíno people, thanks to access to perfectly preserved artifacts, including those not preserved from any other sites. The potential of the Taíno culture, both at Cenote Manantial de la Aleta and throughout the karst region of the Parque Nacional del Este, has certainly not been fully explored yet.

Extremely interesting are the similarities in the vision of caves in Taíno religion and cosmology, as bidirectional portals to the otherworld, or the symbolism of the enormous tree as *axis mundi* growing through its three levels – coinciding with Maya cosmology. Manantial de la Aleta researchers themselves allude to sacrifices made in cenotes in the Maya world (Maus *et al.* 2017: 215). The Taíno plazas of Greater Antilles were used i.e. for recording astronomical events and the Taíno version of the ball game (Keegan and Carlson 2008:6; Oliver 2009: 19–22). The Caribbean, according to current knowledge, lies beyond the geographically undefined cultural boundaries of Mesoamerica (Feinman 2019; Kirchhoff 1943; Szymanski 2020:2), so it is difficult to determine whether the aforementioned similarities are effects of diffusionism or convergence. While evidence for regular commodity and cultural exchange between Maya and Taíno peoples is so far lacking, in-depth research at the cenote Manantial de la Aleta could perhaps also shed some light on this extremely interesting problem for Mesoamerican researchers.[23]

The potential of Casimiroid culture

Archaeologists have noted similarities between lithic artifacts of the first colonists of the Greater Antilles (ca. 3500–2000 B.C.) and those archaic from eastern Yucatán Peninsula, specifically northern Belize, and the Yucatecan origin for the first Caribbean migrants is now considered probable[24] (Oliver 2009: 11; Wilson *et al.* 1998:342). The Casimiroid culture is, according to current state of knowledge, the first wave of human migration in the Caribbean, with the oldest dates to date 5780–6180 BP (MacPhee *et al.* 2007; Moore 1991; Wilson 2007: 33–36; Wilson *et al.* 1998; Veloz Maggiolo and Vega 1982). In the cave of Manantial de Padre Nuestro, some 20 km from the cenote Manantial de la Aleta, in addition to the mostly utilitarian Taíno pottery, preceramic lithics were discovered, classified as belonging to the Casimiroid culture, the first inhabitants of Hispaniola. Six arrowheads of flaked chert cores were found during the cave survey. Casimiroid lithics and shell utensils dating to 3380 ± 60 BP were excavated in the nearby town of Bayahibe (Atiles and López 2007: 540,544; Kay *et al.* 2011: 124; Maus *et al.* 2017: 206–207).

As noted by Kay *et alia* (2011: 124), preceramic lithics have been encountered quite far away in the Manantial de Padre Nuestro cave, although far away in this case does not mean more than 335 m.[25] Human skeletons from the Riviera Maya have been found at distances of over a kilometre from the nearest known cave entrance (Stinnesbeck *et al.* 2020: 3–4, Figure

[23] The problem of the indeterminacy of the geographical and cultural boundaries of Mesoamerica was the subject of the entire XXV conference of the EMC (25-th European Maya Conference) held in Warsaw in 2020.

[24] Also avocado and maize probably were brought to Caribbes from Mesoamerica (Oliver 2009: 15–16).

[25] The total length of the Manantial de Padre Nuestro system, meaning the de facto sum of the length of all its passages (Rosenberger *et al.* 2015: 87). The cartography of the system was done in 2010 by DRSS president Cristian Pittaro, cave explorers Dave Pratt and Thomas Riffaud of DRSS participated in the data acquisition with him (Dominican Republic Speleological Society): https://www.dr-ss.com/padre-nuestro.

1B),[26] raising the prospect that as cave exploration on Hispaniola continues, similar Casimiroid footprints may be found there as well.

Also, given the immense value of the Manantial de la Aleta cenote as a source of drinking water and, as stressed by de las Casas (1909: 10–11), the only source of drinking water in the vicinity, there is no reason why a potential Casimiroid population eventually inhabiting the southern part of present province of La Altagracia would not have known about it and had been using it, if only for purely utilitarian purposes. The remains of the use of the Manantial de la Aleta cenote by the Casimiroids should be found in the deeper layers of the debris cone.

The paleobiological potential

Rich palaeobiological material has been also discovered in Manantial de Padre Nuestro cave system (Bayahibe, Dominican Republic). Between 2009 and 2012, in Padre Nuestro and La Jeringa cave, 0.5 km away, further remains were discovered of *Antillothrix bernensis*[27] primate, species endemic to Hispaniola, for which the type site is Cueva de Berna (Boca de Yuma, Dominican Republic), located just outside the Parque Nacional del Este, 22 km away. This is the richest known accumulation of extinct primates in the Caribbean to date (Halenar *et al.* 2017; Kay *et al.* 2011; Rosenberger *et al.* 2011; Rosenberger *et al.* 2015).

The Padre Nuestro cave system is also rich in bones of other mammals. Thousands of specimens of at least seventeen species from five different orders have been found there, including extinct sloths: *Parocnus serus*, *Neocnus dousman*, *Acratocnus ye*), extinct rodents (*Isolobodon portoricensis*, *Brotomys voratus*, *Hexolobodon phenax*) and extinct shrews (*Nesophontes paramicrus*, *Nesophontes hypomicrus*, *Nesophontes zamicrus*), most of which are known only from Hispaniola, and possibly some of them from the surrounding islands (Halenar *et al.* 2017: 135; Rosenberger *et al.* 2015: 87)

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[26] Chan Hol 2 = 1027 m (cave explorer Harry Gust 2012), Chan Hol 3 = 1141 m (cave explorers Vicente Fito and Ivan Hernandez 2016).

[27] The remains of two individuals were discovered, in two different chambers of the Manantial de Padre Nuestro system, a third individual in Cueva La Jeringa; among others, Phillip Lehman, Vice President of DRSS (Dominican Republic Speleological Society).

The extensive karst decorations in Padre Nuestro indicates that the cave was dry in the past. Dating from at least the middle Holocene, material was found less than 50 m from the cavern entrance, at depths of 5–10 m. Working hypotheses assume that the Manantial de Padre Nuestro was not flooded until ~6,500 years ago, when the global ocean level approached about 3 m below current levels, having risen 22 m in the preceding 1500 years (Fleming *et al.* 1998; Kay *et al.* 2011: 124).

Similar accumulations of extinct Pleistocene and Holocene fauna are known from numerous formerly arid sites in the Yucatán Peninsula. In the Pool 1 cenote, in Cara Blanca, Belize, numerous fossil bones of Pleistocene megafauna have been found, including the sloth *Eremotherium laurillardi* (McDonald 2011: 46; 2015: 118,1221) and these are only the first discoveries of this species in Belize, made in this case thanks to the involvement of cave explorers[28] as part of the project (Lucero 2011: 46–49, Trześniowski 2018: 111). The extinct Pleistocene megafauna is known from a number of numerous sites in the Riviera Maya (Quintana Roo, Mexico), including Cenote Zapote, where a new species of sloth *Xibalbaonyx oviceps* was discovered (Stinnesbeck *et al.* 2017),[29] in the karst well of Hoyo Negro, where it was discovered, among the others, a new species of sloth *Nohochichak xibalbahkah* (McDonald *et al.* 2017)[30] and Cenote The Pit (Luis Leal, personal contact 2020), all three of them morphologically very similar to cenote Manantial de la Aleta.

The aforementioned divagations describing the archaeological potential of the Manantial de la Aleta cenote in reference the Taíno culture, which has not been fully explored during the research to date, the potential of the Casimiroid culture, and the palaeobiological potential as well, dictate a thoughtful and well-prepared return to the site and its thorough investigation. This is finally postulated by the primary researchers of the site: Geoffrey W. Conrad, John W. Foster and Charles D. Beeker (Maus *et al.* 2017: 212,216).

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[28] Cave explorers that took part in the Cara Blanca project: Bil Philips†, Kim Davidsson, Robbie Schmittner, Chip Petersen, Patrick Widmann i Marty O’Farrell (Trześniowski 2018: 61).

[29] Cave explorer Vincente Fito 2009 (Stinnesbeck *et al.* 2020: 4).

[30] Cave explorers: Alex Alvarez, Alberto Nava Blank and Franco Attolini 2007 (Chatters *et al.* 2017: 120).

Back to the Future – How to do it next time?

Risk and potential of a cave system

Further exploration of the Manantial de la Aleta should be treated with extreme caution, as it may always turn out to be the cavern zone of a cave system, connected somewhere in the deeper parts. The history of underwater archaeology knows similar cases, such as the investigations of Cara Blanca cenote in Belize,[31] cenote Sac Uayum in Mayapan,[32] or cenote Xlacah in Dzibilchaltun, where the involvement of cave explorers instantly changed the perspective, broadening the horizon of the research, and a project previously conducted in semi-open waters suddenly found itself partly or entirely overhead (Trześniowski 2018: 62,67,85,87,90), therefore a full exploration of the Manantial de la Aleta cenote should be carried out by experienced underwater cave explorers

Risk and potential of a depth

Measuring probably about 73 m, Manantial de la Aleta is a quite deep sinkhole. However, analogies from the Yucatán peninsula show that it is in these kinds of deep well-traps such as The Pit (Riviera Maya, Quintana Roo, Mexico), Cenote Zapote (Riviera Maya, Quintana Roo, Mexico), Hoyo Negro (Riviera Maya, Quintana Roo, Mexico) or Cara Blanca (Belize) have seen groundbreaking archaeological and palaeobiological discoveries, such as new, hitherto unknown species of Pleistocene megafauna, or the remains of Paleoindians – the first inhabitants of Central America. The remains of *Xibalbaonyx oviceps* – a new species of sloth from cenote Zapote – were discovered at depths of 50 to 55 m, the rich build-up of Pleistocene megafauna at Hoyo Negro is located at depths of 40 to 62 m. The remains of the

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[31] At Cara Blanca, cenote Pool 1 has been estimated to be about 30 m deep for several consecutive research seasons, and has only been explored to 20 m. In reality, it exceeds 62 m depth, and in the northern wall of the cenote, at a depth of 30 m, the 40 m wide entrance to the Actun Ek Nen cave corridor begins. The cave entrance descends all the way to the bottom of the cenote. The corridor goes at least 50 m deep into the cliff and has over 70 m of depth. It is probably the deepest inland underwater cave in Belize (Trześniowski 2018: 62,67).

[32] During the survey of the cenote Sac Uayum, the semi-open cavern turned out to be the antechamber of a multi-chamber cave system, with the most interesting archaeological material only in the second, deeper chamber (Trześniowski 2018: 90).

Naya of Hoyo Negro – the most famous Central American Paleoindian today – were also found at the bottom of this well-trap (Chatters *et al.* 2014; Chatters *et al.* 2017; McDonald 2011; 2015; McDonald *et al.* 2017; Stinnesbeck *et al.* 2017).

During the project activities in the Manantial de la Aleta between 1996 and 1999, artifacts spotted down to a depth of 71 m were reported (Beeker *et al.* 2002: 9), and researchers also noted a significant accumulation of round calabashes, retained by a tree trunk at a depth of about 50 m (Foster and Beeker 1997: 30, Figure 3) – obviously, in other parts of the slope devoid of such barriers, calabashes and other artifacts of round shape may have rolled down to the very bottom of the well so, future seasons of underwater research at Manantial de la Aleta should involve a thorough survey of the deepest parts of the cenote.

The Plan

Deeper parts of the cenote could be surveyed by R.O.V.[33] and how John Foster has admitted (personal communication 2021) there are some plans to do precise mapping of the Manantial de la Aleta using tethered remote vehicles. It can be however more much accurate to leave the job to the experienced technical cave divers.

Open circuit diving in Manatial de la Aleta should be carried out in a two-tank configuration, using EAN 28 gas to a depth of 40 m or much better TMX 21/35 to a depth of 50 m. Decompression after such dives should be accelerated with EAN 50 and pure oxygen, decompression cylinders should be suspended at the depths of 21 m (EAN 50) and 6 m (O_2) at the so-called deco bars. During the immersion, the diver should deposit a fresh oxygen cylinder assigned to himself on the 6 m deco bar or check the pressure in the cylinder previously deposited there (an oxygen deposit in a 11.1 l cylinder should be sufficient for several dives), as well as an EAN 50 cylinder at a depth of 21 m. Runtimes for basic and emergency decompression should be listed on slates being the basic equipment of each diver taking part in an underwater research.

[33] R.O.V. – remotely operated underwater vehicle is a tethered underwater device that, thanks to underwater lights and cameras can be used for survey of the deeper caves or the ocean bottom.

At a depth of 22 m, a permanent platform could be suspended using buoys or inflatable boats that could serve as an underwater laboratory for photogrammetry, without the need to extract artifacts from the water and deprive them of the anoxic environment that has protected them so well for centuries. After detailed documentation, the artifacts would be put back in place, or deposited in specially designated areas of the cave. Standard EAN 36 or bestmix[34] EAN 43 could be used as enough for this particular work.

EAN 28 is a bestmix for a depth of 40 m, with an assumed operational oxygen partial pressure $P0_2$ of 1,4 ATA, it should maximise the possibility of archaeologists to work at depth in the range from the talus peak (34–40 m). As a last resort, air can be used instead of bestmix for work at the platform and near the top of the talus, but accelerated decompression will take some longer in this case. TMX 16/35 is the standard gas to the depth of 50 m, it can extend the range of research work on the talus surface by another 10 m. More than one working dive per day should not be planned.

For deeper parts of the debris cone and the bottom of the cenote (40–73 m or 50–73 m) a closed circuit rebreather (CCR), with O_2 and TMX 12/60 gases, is recommended. Due to the increased risk of sudden unconsciousness during closed circuit rebreather dives, all CCR dives shall be carried out with appropriately prepared teams. Prior to the actual research work, the entire team must be additionally trained in rescue procedures to enable the efficient extraction and lifting of an unconscious diver from the water.

A lift should be installed above the main entrance to the cenote to enable divers to be lifted out of the water, minimising the effort after decompression dives. Equipment and divers can be lifted out of the water together or separately. Backup winch, in case of any malfunction of the basic one, should be at the disposal of the surface support team.

There are probably three hyperbaric chambers in Dominican Republic, but DCS contingency plan should be agreed with DAN (Divers Alert Network).

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[34] Bestmix is obtained from the formula $FO_2 = PO_2 / P$, based on Dalton's law, where F – the desired proportion of oxygen in the mixture, PO_2 – the permissible partial pressure of oxygen during the dive, P – the ambient pressure prevailing at the maximum depth of the dive.

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