Journal of Archaeological Science: Reports 19 (2018) 52–63

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

journal homepage: www.elsevier.com/locate/jasrep

# Shallow geophysical exploration at the ancient maritime Maya site of Vista Alegre, Yucatan Mexico

Roy Jaijel[a,*], Mor Kanari[b], Jeffrey B. Glover[c], Dominique Rissolo[d], Patricia A. Beddows[e], Zvi Ben-Avraham[a], Beverly N. Goodman-Tchernov[a]

[a] Department of Marine Geosciences, University of Haifa, Haifa, Israel
[b] Israel Oceanographic and Limnological Research, Haifa, Israel
[c] Department of Anthropology, Georgia State University, Atlanta, GA, USA
[d] Center of Interdisciplinary Science for Art, Architecture, and Archaeology (CISA3), University of California, San Diego, CA, USA
[e] Department of Earth and Planetary Sciences, Northwestern University, Evanston, IL, USA

ARTICLE INFO

*Keywords:*
Yucatan
Seismic
Stratabox
Geoarcheology
Coastal geomorphology

ABSTRACT

Geophysical methods are of great value when investigating or searching for archaeological sites because of their ability to cover a large area in a short time and reveal features and aspects of unexcavated locations. In submerged archaeological sites, the use of seismic survey methods is especially important, as the excavation process is more complicated than at typical terrestrial sites. While the terrestrial portion of the maritime Maya site of Vista Alegre, located in the northeastern part of the Yucatan Peninsula, has been mapped and partially excavated, the shallow offshore flooded landscape has not, in part due to difficulties determining the best targets for initiating the effort. Results from an earlier sediment core campaign resolved the character, environmental associations, and ages of underlying sediments, but could only minimally predict the presence of laterally continuous features due to the distance between cores. To resolve this issue, a seismic survey was conducted to extrapolate the spatial extent of these strata. The survey area covered the flooded bays flanking the terrestrial portion of Vista Alegre. This area has been affected by sea-level rise throughout time, and was a likely location of maritime activity in the past. Results from this study provided laterally continuous evidence for sea-level rise, reinforcing the previous study; and also identified the presence of a submerged ridge-basin structure. This structure was unexpected because it was neither continuous nor congruous with natural trends observed terrestrially. This uniqueness could be attributed to significant differences in the submerged landscape, and possibly the presence of anthropogenically-altered offshore features. The interpreted seismic data is useful both for a site-scale spatial understanding of the flooded landscape history, as well as for identifying potential locations for shallow water archaeological excavations.

## 1. Introduction

### 1.1. Submerged archaeological features

The position of a coastal archaeological site relative to the shoreline is dynamic (Benjamin et al., 2017). Therefore, identifying its features or reconstructing the site's full configuration requires subsurface knowledge, both on land and underwater. Depending on various natural and anthropogenic processes, dry portions of a site can become flooded while submerged features can become terrestrial. Amongst the interrelated natural processes affecting coastal archaeological sites are relative sea-level changes (Morhange et al., 2001; Mourtzas and Kolaiti, 2017; Mourtzas, 2017), tectonic movements (Minor and Grant, 1996; Mourtzas and Marinos, 1994), sediment transport, erosion, deposition (Andreou et al., 2017; Kraft et al., 2003; Marriner et al., 2006), and possible combinations of those (Bailey and Flemming, 2008; Benjamin, 2010). These natural processes may have changed the relative location of the coastal site, for example, transforming a once coastal marine harboring area into a modern terrestrial feature by infilling; or submerging a coastal site due to sea-level rise (e.g. Benjamin, 2010; Faught and Donoghue, 1997; McKillop, 1995; Raban and Galili, 1985); or uplifting a site by tectonic movements (e.g. Mourtzas and Kolaiti, 2017; Pirazzoli et al., 1992).

During the Holocene, a general sea-level rise trend is recognized globally (Fairbanks, 1989; Fleming et al., 1998) which carved new shorelines and submerged many prehistoric and historic coastal sites

* Corresponding author.
*E-mail address:* rjaijel@campus.haifa.ac.il (R. Jaijel).

https://doi.org/10.1016/j.jasrep.2018.02.018
Received 19 August 2017; Received in revised form 13 February 2018; Accepted 14 February 2018
2352-409X/ © 2018 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/BY/4.0/).

(Benjamin et al., 2017; Benjamin, 2010; Flemming, 1972; Galili et al., 1993; Galili and Weinstein-Evron, 1985; Masters and Flemming, 1983). The flooding of these sites has made them more elusive and harder to locate and characterize than their terrestrial counterparts. This results in a general lack of information about the maritime component (e.g. harbor morphology; marine infrastructure in general) of many ancient societies. Over the past 3000 years, the Yucatan Peninsula was influenced by a sea-level rise of ~2 m (Khan et al., 2017; Toscano and Macintyre, 2003). There is evidence that this sea-level rise submerged certain parts of some ancient Maya coastal archaeological sites (Andrews and Corletta, 1995; McKillop, 2005).

In addition to impacting archaeological resources, sea-level rise has affected the interactions between marine and fresh waters along the coast of the Yucatan Peninsula. The highly karstic peninsula has an absence of true surface rivers north of Belize, with the exceptional dissolution-enhanced permeability leading to all drainage via extensive flooded conduits, or cave systems, which might have an outflow to the ocean. Sea-level changes affect the aquifer water level, which can lead to changes in the morphology of the karstic caves, channels, and sinkholes (locally called cenotes) (Beddows, 2003, 2004; Gabriel et al., 2009; van Hengstum et al., 2010; Wollwage et al., 2012), and by extension freshwater sources, clearly an imperative for past coastal inhabitants, much as it is today (see Beddows et al., 2016).

This research focuses on the ancient Maya coastal site of Vista Alegre, which is located along the north coast of the Yucatan Peninsula (Fig. 1). The site has evidence of occupation from the Middle Preclassic period up to the time of Spanish contact (750 BCE – 1521 CE), although the site's occupational history is not continuous nor did the site's function remain unchanged for over two millennia (see Table 1; Glover et al., 2011). One particular role the site served during the Terminal Classic period (850–1100 CE) was to facilitate long-distance, coastal trade (Glover et al., in press). These maritime activities are well attested ethnohistorically, iconographically, and archaeologically; however, the specific details regarding the infrastructure associated with ancient Maya port sites is less documented. Previous studies at the site have found a general trend of sea-level rise (Jaijel et al., 2018), and the possibility that portions of the archaeological site are currently flooded. The geophysical study helps both in completing the environmental history of the site, and in locating possible targets for future marine archaeological excavations.

### 1.2. Geophysics

Geophysical methods are central to underwater archaeological exploration and can provide information both on natural and anthropogenic processes that affect a site over time (e.g. Papatheodorou et al., 2017; Wynn, 1986). The main advantages of geophysical methods in marine areas are the ability to identify subsurface changes and contrasting features, and more efficiently cover a large lateral area; particularly relative to underwater excavation, probing, coring, or dredging. This provides a spatial understanding of natural and anthropogenic processes, and can reveal different buried features with little to no disturbance. Of the geophysical methods available, seismic reflection is one of the more common methods used for general subsurface marine exploration. Seismic surveys are used in submerged archaeological research in order to resolve a range of issues such as:

a) Locating and describing buried artifacts, wrecks and infrastructure (e.g. Grøn et al., 2015; Müller et al., 2009; Quinn et al., 1997b; Sakellariou et al., 2007)
b) Studying the geological record by characterizing sedimentary horizons, which can be related to different periods of the archaeological site, e.g. occupation and abandonment (Goodman-Tchernov and Austin, 2015; van Andel and Lianos, 1984); and/or
c) Locating evidence of past natural events, such as tsunamis, river incision and transgression and regression of sea level (Faught and Donoghue, 1997; Stright, 1986)

Recognizing these kinds of natural and manmade underwater features is important for completing the history of a site, revealing its true lateral dimensions and particular maritime function/s.

### 1.3. Vista Alegre physical background

The maritime Maya site of Vista Alegre is located along the north coast of the Yucatan Peninsula, in the modern state of Quintana Roo, Mexico (Fig. 1). The terrestrial area of Vista Alegre is located on a now-forested island of 16 ha, that is flanked by two bays on its east and west sides (Fig. 1). The surrounding coastal environment is a patchwork of different features such as marshland, hypersaline basins, mangrove islands, tidal flats, and small tidal creeks with varying water salinities. The water depth varies from a few centimeters to 2–3 m, with a microtidal, semi-diurnal mixed-tide regime where amplitude can reach up to a meter. During strong northerly winds the tide variation may reach higher values, adding up to a few decimeters to the gravity tide. The site is only accessible by boat, and the shallow bays around the site require small, shallow draft boats which present particular challenges when working with seismic equipment.

Sediment cores were extracted in 2011 from the bays surrounding Vista Alegre for purposes of environmental and geomorphological reconstruction of the site (Beddows et al., 2016; Jaijel et al., 2018; Fig. 2). Results from that work revealed changes in Vista Alegre's shoreline morphology over the past 3000 years. Described generally, the now shallow bays around the site were once deeper, despite lower sea levels, and at least some of the present-day hypersaline shallow basins did not exist, such as the one located to the northwest of the presently known occupation site, referred to by project members as the “Dead Zone” (Fig. 2; see Jaijel et al., 2018). Rather, the area surrounding the archaeological site was less restricted than today (flanked by open bays), and was more similar to the Holbox Lagoon. That environmental setting would have been conducive to maritime activity at the site, with easier access first to Holbox Lagoon and then out to the open sea. This also would have made the site more prominent along the coast. In agreement with broader sea-level rise studies performed in the Caribbean (Toscano and Macintyre, 2003), coastal flooding occurred, although the rate and response appears to have some localized variations that may reflect site-specific complexities (Jaijel et al., 2018). The present day shallow, restricted bays are a result of sediment infill, a process most likely enhanced by the presence of mangroves (Alongi et al., 2005; Furukawa et al., 1997). Several depositional phases were defined from the sediment core study, and some of those correlated to the archaeological chronology of the site.

### 1.4. Vista Alegre archaeological background

A total of 40 structures and features have been mapped at the site to date (Fig. 1B). These range from low-lying linear features along the margins of the island, to large domestic platforms, and even a pyramid structure that rises 11 m above sea level to offer impressive views of the mainland and Holbox Lagoon (Glover and Rissolo, 2017). The site's architecture clusters in the northern portion of the island and is delimited to the south by a 400 m long wall that extends across the entire island (Fig. 1B). This feature is of particular interest to this research because of its continuation into the East Bay and also into the mangroves that flank the West Bay.

Based on archaeological evidence collected by the Proyecto Costa Escondida, Vista Alegre was home to some of the earliest Maya peoples in the northern portion of Quintana Roo. This evidence is primarily in the form of ceramic vessels and figurines (Glover et al., 2012; Table 1). Initial occupation was followed by a robust population, based on volume and frequency of pottery types, during the Terminal Preclassic and Early Classic periods (Vista Alegre IIa). The population at the site

Download English Version:

https://daneshyari.com/en/article/7444517

Download Persian Version:

https://daneshyari.com/article/7444517

Daneshyari.com