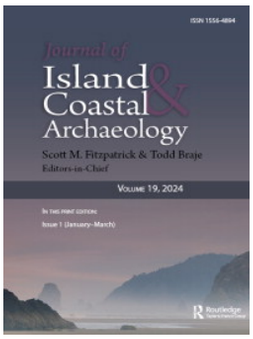

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RAPID COMMUNICATION

Radiocarbon dates from Curaçao's oldest Archaic site extend earliest island settlement to ca. 5700 cal BP

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ABSTRACT

Due to its proximity to coastal South America and settlement during the early phase of insular Caribbean occupation, Curaçao's archaeological record offers potential evidence for early overwater exploration and regional interaction. Here, we report new accelerator mass spectrometry (AMS) dates on charcoal from C-1426 at Saliña Sint Marie, an Archaic rockshelter site that extends Curaçao's occupation back to 5735–5600 cal BP, some 290–850 years earlier than the established settlement chronology. This finding makes the C-1426 rockshelter Curaçao's earliest known archaeological site and among the oldest in the insular Caribbean. We describe the site and the archaeological context of dating and conclude by considering the implications of Curaçao's revised occupation chronology for initial Caribbean settlement.

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KEYWORDS
ABC Archipelago; Archaic Age; Caribbean; chronometric hygiene; island colonization

Introduction

The island of Curaçao lies in the Leeward Antilles of the Caribbean (Figure 1A). It is separated from Venezuela's Falcón state by a 65.5 km stretch of the Bonaire Basin, a deep-water trench present throughout the Holocene, which Curaçao's first inhabitants would have crossed to reach the island. Archaeological research indicates Curaçao was settled during the Archaic Period by fisher/hunter-gatherers from northwest Venezuela, who may have been attracted by the island's rich marine resources (Haviser and Hofman 2015). The earliest evidence for their activity is recorded at the Rooi Rincon site, dated ca. 5300–4900 BP (Tamers 1967, see also Haviser 2001). Archaic occupation persisted until 1200–1400 years ago when Dabajuroid migrants from South America arrived, introducing wide-scale agriculture and ceramic technology. Their descendants are the historical Caquetío, whom the Spanish encountered upon their arrival in 1499, and who remained on the island into the nineteenth century when it was a Dutch colony (1634–1954). Today Curaçao is an autonomous country within the Kingdom of the Netherlands.

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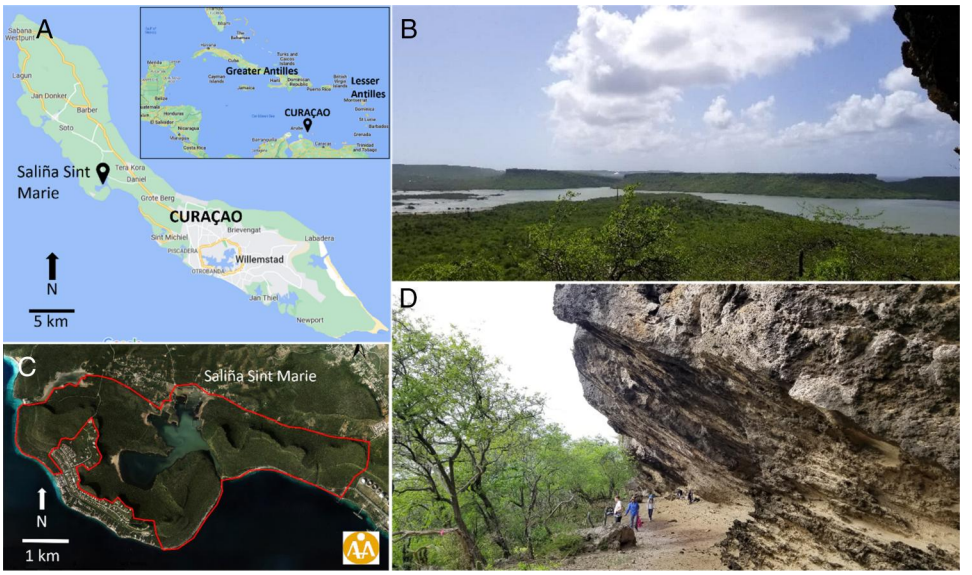

Figure 1. (A) Map of Curaçao and the Caribbean showing locations mentioned in the text (base map: Google); (B) the Saliña Sint Marie landscape investigated by the CCLP, outlined in red (image: GoogleEarth); (C) view of Saliña Sint Marie surrounded by uplifted limestone terraces; (D) the C-1426 rockshelter site, facing South (Photo: C. Giovas).

The Curaçao Cultural Landscape Project (CCLP) was established in 2018 as an international, multidisciplinary collaboration among five partners (see author affiliations) to investigate long-term biodiversity change and its relationship to human settlement and land use on the island. Here we report on new findings and accelerator mass spectrometry (AMS) dates from a significant rockshelter site (C-1426) at Saliña Sint Marie, where the CCLP initiated archaeological testing in 2022.

The C-1426 rockshelter site

The Saliña Sint Marie landscape (ca. 180 ha) comprises an inland bay surrounded by mangroves, historical salterns, and uplifted limestone terraces situated on Curaçao's western coast (Figure 1B and C). The C-1426 rockshelter site lies approximately 1 km upland from the bay on an outcropping rock ledge. Prior pedestrian survey by the Archaeological Working Group Curaçao flagged the site's presence based on surface scatters of lithic artifacts, bone, and shell extending over much of the rockshelter's approximately 60 m length (Figure 1D). In 2022, one 1 m × 1 m unit and three 50 cm × 50 cm squares (in three units) were excavated following natural stratigraphy, subdivided into arbitrary 5 cm increments: Unit 357 lies beyond the dripline; Unit 486 is partially protected by a large roof-fall boulder; and Unit 392 and Unit 393 lie within feature F001, one of three large (ca. 1–2 m diameter) combustion features (Figure 2). The excavated squares of feature F001 revealed complexly arranged lenses of ashy sediments containing abundant burned marine and terrestrial shells, fish bones, and charcoal (Figure 2C). To date, only Square 1 in Unit 486, which contained marine and terrestrial faunal remains, has been excavated to sterile subsoil.

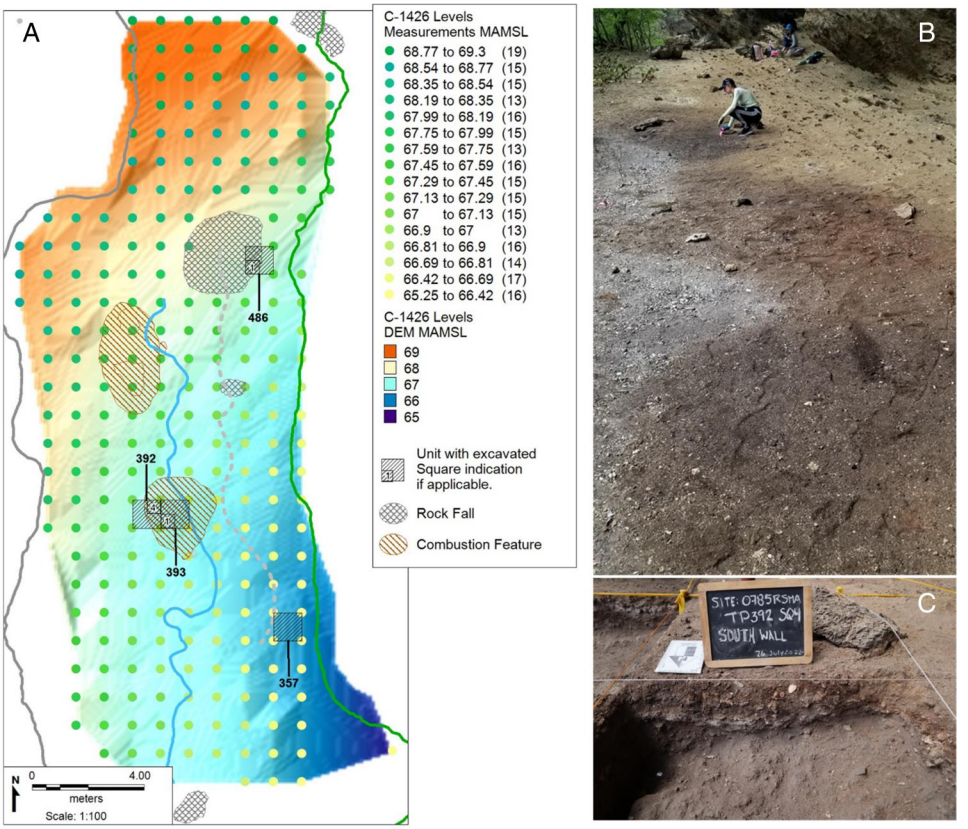

Figure 2. (A) Digital elevation model (DEM) of C-1426 rockshelter dimensions indicating features and units mentioned in text and meters above mean sea level (MAMSL); (B) three large combustion features visible on the surface, facing South (Photo: C. Giovas); (C) south profile wall of Unit 392 showing ash lenses, with partial view of Unit 393 in left frame (Photo: NAAM).

The rockshelter setting, chert flakes, and dearth of ceramic sherds strongly suggested Archaic Period occupation. To confirm site chronology, provenienced wood charcoal pieces were collected from Unit 392 (UOC-21866), Unit 393 (UOC-21867), and from the lowermost cultural deposit in Unit 486 (UOC-21868), and submitted to the University of Ottawa, AE Lalonde Lab for AMS radiocarbon dating (Table 1). Charcoal wood species are unknown, but care was taken to select smaller fragments less likely to derive from "old wood," although this cannot be ruled out entirely in the absence of anthracological analysis.

Methods

Sample pretreatment and processing methods are described in Crann et al. (2017) and Murseli et al. (2019). Radiocarbon analyses were performed on an Ionplus AG MICADAS (Mini Carbon Dating System). $^{12,13,14}C+^{1}$ ions were measured at 200 kV terminal voltage with He stripping. Data were processed using the BATS data reduction software as described by Wacker, Christl, and Synal (2010). The fraction modern carbon, $F^{14}C$, was calculated according to Reimer, Brown, and Reimer (2004) as the sample

Table 1. AMS assays for the C-1426 rockshelter site, Curaçao.

Lab No.	Find No.	Sample type	Context	^{14}C yr BP±	Years cal BP, 2σ
UOC-21866	0785RSMA0020SAC14	Wood charcoal; undetermined species	Site C-1426, Saliña St Marie, Curaçao: F001, Unit 392, Sq. 4, 87 cmN, 28 cmE, 19.5 cm below local datum	4708 BP ± 17	5555–5324
UOC-21867	0785RSMA0153SAC14	Wood charcoal; undetermined species	Site C-1426, Saliña St Marie, Curaçao: F001, Unit 393, Sq. 1, 9 cmN, 10 cmE, 32 cm below local datum	4652 BP ± 17	5462–5316
UOC-21868	0785RSMA0087SAC14	Wood charcoal; undetermined species	Site C-1426, Saliña St Marie, Curaçao: Unit 486, Sq. 1, Pl. 1, 45 cmN, 9 cmE, 26 cm below local datum	4964 BP ± 17	5734–5603

Note: All dates calibrated using OxCal v4.4.4 and IntCal20.

$^{14}C/^{12}C$ ratio to the standard $^{14}C/^{12}C$ (Ox-II) measured in the same data block. Both $^{14}C/^{12}C$ ratios were background-corrected. The result was corrected for fractionation (occurring both from spectrometer and sample preparation fractionation) using the online AMS measured $^{13}C/^{12}C$ ratio and is normalized to $\delta^{13}C$ (PDB). Radiocarbon ages were calculated as $-8033\ln(F^{14}C)$ and reported in ^{14}C yr BP (BP = AD 1950), as described by Stuiver and Polach (1977). Errors on ^{14}C ages (1σ) are based on counting statistics and $^{14}C/^{12}C$ and $^{13}C/^{12}C$ variation between data blocks. AMS $\delta^{13}C$ is not reported due to machine-induced fractionation. All ^{14}C dates discussed below were calibrated using OxCal v4.4.4 (Bronk Ramsey 2021) and the IntCal20 calibration curve (Reimer et al. 2020). Dates are reported to 2σ in years cal BP (Table 1).

Results and discussion

The two wood charcoal samples from combustion feature F001 yielded closely aligned calibrated date ranges of 5555–5324 BP (UOC-21866, 4708 BP ± 17) and 5462–5316 BP (UOC-21867, 4652 BP ± 17). The charcoal sample from the basal cultural layer of Unit 486 provided an older, calibrated date of 5734–5603 BP (UOC-21868, 4964 BP ± 17). The clustering and stratigraphic consistency of the dates support sound correspondence between the timing of rockshelter occupation and the death of the trees/shrubs used for fuel. All three ^{14}C assays from the rockshelter predate Curaçao's previously known, oldest radiocarbon assay on charcoal (species unreported) from the site of Rooi Rincon (4490 BP ± 60, IVIC-247; recalibrated using IntCal20 to 5315–4885 cal BP) (Tamers 1967, 244). This latter date was obtained before the late 1970s, when measured ages began to be corrected for fractionation, and requires re-verification for accuracy. The three newly reported assays for C-1426 constitute the oldest, culturally associated radiocarbon dates for Curaçao. The lack of overlap between the basal date for Unit 486 and those of Unit 392 and Unit 393 suggests the site was (re)used intermittently or over an extended period. This conclusion is supported by marine shell accumulations extending down the steep slope in front of the rockshelter.

Curaçao's geographic position and record for early Archaic occupation raise questions about the relationship of its first inhabitants to other early Archaic Caribbean groups and possible entanglement in the migration(s) of Indigenous peoples from the continent

to the Antilles. While ancient DNA (aDNA) analysis reveals genetic affinities between Curaçao's later Ceramic Age (post-1200 BP) population and the Lesser Antilles (Fernandes et al. 2021), aDNA studies of Curaçaoan Archaic peoples are lacking. In the absence of these data, the timing of Curaçao's initial settlement relative to other early Caribbean sites can help to constrain possible relationships. In principle, the first Caribbean island settled by humans was Trinidad, ca. 7900–7800 cal BP (Tankersley et al. 2018). However, due to its proximity to South America and the fact that it may have held lingering dryland connections to the continent during the early Holocene (Rivera-Collazo 2019), Trinidad is generally excluded from discussions on the peopling of the insular Caribbean proper, i.e., where a significant open-water crossing would have been required.

In the latter instance, there is a general consensus that Cuba and Hispaniola were the first islands settled, beginning ca. 6500–6000 BP (e.g., Chinique de Armas et al. 2020; Keegan and Hofman 2017), with Puerto Rico occupied 1200–1500 years later (Rivera-Collazo 2019; Rodríguez-Ramos, Torres, and Oliver 2010). While the source of these Archaic settlers is debated, Central America (Yucatan peninsula or Belize), the Isthmo-Colombian region, and northwestern South America have been proposed (see Callaghan [2003] and Keegan and Hofman [2017] and references therein). North America is widely discounted due to the absence of material culture connections and difficulty of navigating the powerful currents of the Florida Straits. Overwater travel was almost certainly accomplished by paddled dugout canoes lacking sails (Fitzpatrick 2013). Computational simulations of canoe voyages from Central and South America have shown that watercraft departing from what is today Venezuela had the highest probability of successfully reaching the Greater Antilles, with intentional crossings achievable in under a week even with comparatively little navigational skill or power (Callaghan 2003). Curaçao's proximity to simulation launching points in western Venezuela suggests its archaeological record may inform questions about early overwater exploration and interaction in the western South American region and the timing of population movements that led to the settlement of the insular Caribbean.

Several Greater Antillean sites have reported uncalibrated ages older than 5000 BP, including Vignier III in Hispaniola (5580 ± 80 BP[1], Beta-26796; Moore 1991), Levisa 1 in Cuba (5140 BP ± 170, GD-250; Pino 1995 in Napolitano et al. 2019), and Angostura in Puerto Rico (5960 ± 60, Beta-29778; Rivera-Collazo et al. 2015). A recent chronometric hygiene appraisal of nearly 2500 Caribbean ^{14}C assays by Napolitano et al. (2019), however, downgraded the reliability of many of these dates for reasons that include insufficient contextual information, missing lab numbers, legacy status, and unknown sample material. Using a vetted radiocarbon database, the authors conducted Bayesian modeling and arrived at likely (*95.4%*) colonization dates of *5360–4675 cal BP* for Cuba, *4545–3930 cal BP* for Hispaniola, and *4655–4305 cal BP* for Puerto Rico (Napolitano et al. 2019). The new ^{14}C assays reported here for the C-1426 rockshelter antedate these modeled colonization date ranges but overlap nearly completely with the modeled range for Curaçao, *5685–4845 cal BP* (Napolitano et al. 2019). Because further research is required to verify earliest settlement chronology for Cuba, Hispaniola, and Puerto Rico relative to chronometric hygiene results (Napolitano et al. 2019), it would be premature to conclude C-1426 predates Archaic settlement of the Greater Antilles. As it stands,

therefore, the earliest known use of the rockshelter postdates initial occupation of the Greater Antilles but with the possibility that ongoing refinements to Greater Antillean settlement chronology may reverse this relationship. Regardless of relative timing, material cultural correspondences in the archaeological records of both regions are needed before specific cultural connections based in a shared migration history can be proposed.

Conclusion

The AMS dates reported here for the C-1426 rockshelter span 5735–5600 and 5555–5315 BP, confirming this site as the oldest known in Curaçao and among the oldest in the insular Caribbean. Future field work at the site will allow more robust characterization of artifact assemblages that may illuminate cultural affinities with mainland South America and the Antilles and potential routes for human movement across the region.

Note

1. The publication (Moore 1991) where the Beta-26796 assay was originally reported does not explicitly state the dated material from Vignier III but strongly implies it is marine shell. Elsewhere, this assay is reported as deriving from charcoal (Roksandic and Roksandic 2018) and apparently calibrated using the IntCal calibration curve for Northern Hemisphere terrestrial systems (Rivera-Collazo 2019, Figure 3.1). When calibrated to 2σ using the Marine20 curve (Heaton et al. 2020), this assay produces a date ca. 200–1000 years younger than IntCal20 (Reimer et al. 2020). Our inquiry with the radiocarbon lab which produced the assay revealed that records from this period were destroyed in a hurricane in 1992, and the sample material cannot be verified.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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