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Harsh high-altitude environments were among the last landscapes to be settled by humans during the Late Pleistocene between ~15,000 and 11,000 calendar years before present (cal yr BP). Successful colonization required physiological adaptations to hypoxia and cultural adaptations to limited resources and cold temperatures. How and when humans colonized Andean South America has been poorly understood owing to controversial early archaeological sites and questions about the impact of environmental factors, including the presence of glaciers. Here we report the reexamination and direct dating of six finely woven textiles and cords from Guitarrero Cave, Peru, that identify South America's earliest textiles and show that occupation of the Andes had begun by ~12,000 cal yr BP. Additional evidence for plant processing and fiber-artifact construction suggests women's presence among these earliest foraging groups. Previous research suggested use of the highlands by small groups of male foragers between 15,000 and 13,000 cal yr BP with permanent settlement only after 11,000 cal yr BP. Together these data amplify accumulating evidence for Late Pleistocene/Early Holocene technological sophistication and cultural diversity in South America and are consistent with hypotheses that long-term settlement of higher elevations occurred immediately following glacial retreat.

Most scholars believe that humans colonized South America beginning at least 14,600 cal yr BP and that by 13,000 cal yr BP the continent was a mosaic of diverse cultures resulting from adaptations to environmental variability (Dillehay 2000, 2008; Dillehay et al. 2008; Lavallée 2000; Lynch 1990, 1999; Steele and Politis 2009). Among these early settlers were transhumant foragers occupying Pacific littoral settlements who exploited marine resources but forayed into the valleys and highlands of the Andes to support broad subsistence economies (deFrance, Grayson, and Wise 2009; Dillehay 2000; Dillehay et al. 2008; Lynch 1971; Núñez, Grosjean, and Cartajena 2002; Sandweiss 2008). High-altitude (>2,500 m) environments are typically unwelcoming and pose unique adaptive challenges to humans because of limited resource availability, cold temperatures, and the biological consequences of high altitude such as hypoxia, which affects work capacity, metabolism, and reproduction (Aldenderfer 1998, 2003, 2006, 2008; Richardson 1993). Previous research documents logistical forays into higher altitudes following deglaciation to obtain seasonally available foods and obsidian by at least 13,000 cal yr BP. However, permanent settlement is not clearly indicated until after 11,000 cal yr BP at sites in the central Andes including Asana, Pachamachay, and Telarmachay (fig. 1; Aldenderfer 1998, 2003, 2006, 2008; Núñez, Grosjean, and Cartajena 2002; Rick 1980). Dating of these early sites has been critical to reconstructing the tempo and mode of high-altitude colonization, but most existing dates derive from bone and obsidian, which are often unreliable, and charcoal, which, owing to the use of old wood, may overestimate site age (Aldenderfer 1999; Dillehay 2000; Lynch 1990; Rick 1987). Here we report six new accelerator mass spectrometry (AMS) radiocarbon dates and observations on the plant-fiber-based artifact assemblage from Guitarrero Cave, a site that has figured prominently in debates over the initial peopling of the Andes and South America because of its antiquity and exceptional preservation. These new data identify South America's oldest textiles and revise Guitarrero's controversial initial occupation to between 12,100 and 11,800 cal yr BP (~10,200 radiocarbon years before the present [^{14}C yr BP]), as much as 2,000 calendar years younger than previously thought. The results have implications not only for the timing of high-altitude colonization but also for understanding the technological adaptations that made high-altitude colonization possible and the gender of the hunter-gatherers who produced those technologies.

The Archaeology of Guitarrero Cave, Peru

Guitarrero Cave is located in the intermontane Callejón de Huaylas Valley (2,500–4,000 m) in the north-central highlands of Peru (fig. 1). Situated at an elevation of 2,580 m, excavations defined two early cultural complexes (Lynch 1980). The earliest, Complex I, is characterized by flakes, scrapers, a tanged triangular-bladed projectile point, and the remains of deer and small game including rodents, rabbits, and birds. The overlying Complex II yielded the same and additional species of animals. Cultural materials include triangular, lanceolate, and other contracting-stem projectile points and artifacts made of wood, bone, and plant fiber. The fiber-based artifact assemblage includes four coils and two bundles of finely processed fiber indicative of artifact construction material, 53 lengths of unknotted and knotted cordage of variable diameter, and three fragments of finely woven textiles of different structural techniques (Adovasio and Maslowski 1980). Such exceptional preservation of plant remains allowed rec-

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Figure 1. Map of South America showing high-elevation areas and location of archaeological sites mentioned in text. A color version of this figure is available in the online edition of *Current Anthropology*.

ognition of abundant Bromeliaceae and Agavaceae plant-fiber-processing debris that proportionally outweighs plant-food remains in both the early and late deposits (Smith 1980*a*). The stone industry compares well with those from other early highland sites, and Guitarrero is interpreted as a base camp used by mobile foragers who engaged in a broad-spectrum archaic subsistence economy during the Late Pleistocene/Early Holocene transition (Lynch 1980).

Nearly 40 previously obtained radiocarbon dates suggest intermittent human use of the cave, possibly as early as 15,000–14,000 cal yr BP (table 1). However, doubts remain about the integrity of stratigraphy and cultural deposits and the age of some artifacts and ecofacts (Aldenderfer 1999; Dillehay 2000). Of the previous dates, only six of the earliest are on undisputed artifacts, and these indicate an initial occupation between 12,800 and 10,600 cal yr BP (10,500–9,900 ^{14}C yr BP). It should be stressed that these are early AMS dates that lack the precision of current technique and exhibit standard errors from 130 to 300 years.

New Radiocarbon Dates and Artifact Analyses

Our new analyses entailed reexamination and direct dating of the Complex II fiber-artifact assemblage to (1) confirm the putative antiquity of the textiles, (2) enhance knowledge of their probable form and function, and (3) refine the timing of the site's earliest occupation with contemporary dating techniques. The new dates are presented in table 2, and all of the radiocarbon determinations discussed in this report have been calibrated using OxCal 4.1 for Windows (Bronk Ramsey 2009) and rounded to the nearest decade. Determinations of and before 9,200 ^{14}C yr BP are calibrated using the IntCal09 (Reimer et al. 2009) curve because the ShCal04 (McCormac et al. 2004) curve does not implement a Southern Hemisphere offset correction for pre-Holocene dates.

These dates reveal that the fragment of a spirally interlinked fabric (fig. 2*A*), likely from a bag, is out of stratigraphic sequence and considerably younger than the other artifacts (table 2). This adds to the evidence that early cultural deposits at the site were subject to considerable disturbance by subsequent natural and cultural processes and urges caution when interpreting the age of other artifacts. The antiquity of the twined textiles and cordage is now verified, however. These artifacts were manufactured between 12,100 and 11,100 cal yr BP. One of the twined textiles (fig. 2*B*) is very finely woven, with 4 weft rows/cm and probably came from a piece of clothing or a bag. Despite its open weave, the second twined textile (fig. 2*C*) is also relatively fine, with 2 weft rows/cm. This textile exhibits a dark organic residue of unknown origin on both surfaces, and one side illustrates weft-element surface abrasion from use. The residue, wear, and technological style of this textile are most consistent with use as a mat, although use as a container cannot be ruled out. The three dated examples of cordage (fig. 3) exhibit varying diameters, and the presence of knots on both the dated and undated specimens suggests use in binding or lashing, among other tasks. Stable carbon isotope measurements acquired during radiocarbon analysis corroborate microscopic identification of artifact raw material (see table 2 and below). The cordage, spiral interlinking, and close-twined textile are all made from agave or bromeliad (Agavaceae or Bromeliaceae) leaf fiber that was processed to varying degrees, while the open-twined mat fragment is woven from rush (Cyperaceae) stems.

Two previously published descriptions of the Guitarrero perishable artifact assemblage provide valuable data, but because of space constraints, they were unable to provide detailed specimen-by-specimen data and lacked the chronological certainty provided by direct dating (Adovasio and Lynch 1973; Adovasio and Maslowski 1980). An unfortunate consequence of this has been minimization of the technical and stylistic variability present in the Complex II material as well as a lack of appreciation of the textiles' fineness. As a step toward remedying this, we present detailed metric and analytic data for each of the directly dated specimens. We also consider available evidence supporting on-site fiber-artifact manufacture. A future report will consider our reexamination of the complete Complex II fiber-artifact inventory.

The technical descriptions follow published descriptive terminology and classificatory schemas (Adovasio 1977; Emery 1995 [1980]; Hurley 1979). Artifact examination and botanical identification were performed via unaided eye, with a 10× hand lens, and, as necessary, a dissecting microscope operating at 10× to 35×. Botanical identifications were facilitated by comparison with local (Arizona, New Mexico) examples of Agavaceae and Cyperaceae and G. J. Gumerman IV's comparative South American plant collection at Northern Arizona University, Flagstaff. Because we could not distinguish between outwardly similar South American Agavaceae (e.g., *Agave* spp., *Furcraea* spp.) and Bromeliaceae (e.g., *Puya* spp., *Tillandsia* spp.) fiber species in the artifact assemblage, we recognize that one or more of the species in these families that grow near the cave may be a possible source. Metric measurements were taken using Mitutoyo digimatic point calipers, and documentary photos of each specimen were taken before and after AMS sampling, using a Nikon D200 digital SLR camera. The figures and descriptions represent the artifacts before the removal of small (~10 mg) AMS samples.

Spiral Interlinking (*Fig. 2*A)

Provenience. Complex IIa, square C5, unit 124.

Technique and comments. This specimen is a fragment of spiral interlinking that measures 2 cm long by 1.9 cm wide and 3 mm thick. The fabric is composed of interlinked yarns of tightly S-twisted bunches of Agavaceae/Bromeliaceae fiber that cross right over left and form a down to the right–slanting spiral. Yarns average 0.8 mm in diameter (range 0.7–0.9 mm), and there are 4 yarns/0.5 cm. There is no diagnostic wear or adherent residue beyond some soil matrix.

Table 1. Previous radiocarbon dates from Guitarrero Cave

Lab no.	Radiocarbon age (^{14}C yr BP ± SD)	2σ Cal age (yr BP)	Dated material	Complex	Square, unit	Comments
GX1859	12,560 ± 360	15,780–13,760	Charcoal (pooled?)	I	B2 N1/2, 63	Conventional date
GX1778	10,535 ± 290	12,990–11,400	Charcoal (pooled?)	IIa	B1/A2, 22	Conventional date
GX1780	10,475 ± 300	12,930–11,330	Charcoal (pooled?)	IIa	C6, 159	Conventional date
OxA-197	10,445 ± 130	12,790–11,850	Cordage	IIa	C6, 159	AMS date, 105 years added to conventional age for isotopic correction
SI 1502	10,240 ± 110	12,560–11,400	Charcoal (pooled?)	IIa	C6, 159	Conventional date
OxA-195	10,180 ± 130	12,380–11,320	Bipointed wood dowel	IId	C6, 150	AMS date
OxA-196	10,085 ± 120	12,070–11,250	Cordage	IIc	C5, 122	AMS date, 105 years added to conventional age for isotopic correction
OxA-108	10,000 ± 200	12,390–10,870	Wood dowel	III	B2 S1/2, 35	AMS date
OxA-104	9,930 ± 300	12,600–10,590	Wood batten	IIb	C5, 123	AMS date
OxA109	9,860 ± 200	12,050–10,710	Wood dowel	P	B6, 133	AMS date
GX1779	9,790 ± 240	12,050–10,500	Charcoal (pooled?)	I	B1/A2, 28	Conventional date
SI 1498	9,660 ± 150	11,400–10,560	Charcoal (pooled?)	I	B1/A2, 26	Conventional date
OxA-193	9,600 ± 130	11,230–10,590	Charcoal	IIe	B1/A2, 18	AMS date
SI 1499	9,580 ± 135	11,240–10,560	Charcoal (pooled?)	IIa	B1/A2, 22	Conventional date
OxA-181	9,520 ± 150	11,230–10,420	Charcoal	I	B1/A2, 26	AMS date
SI 1496	9,475 ± 130	11,180–10,410	Charcoal (pooled?)	I	B2 N1/2, 62	Conventional date
OxA-194	9,430 ± 150	11,160–10,300	Charcoal	IIa	B1/A2, 22	AMS date
OxA-184	9,400 ± 150	11,120–10,260	Charcoal	I	B2 N1/2, 63	AMS date
OxA-185	9,350 ± 150	11,090–10,240	Charcoal	I	B2 N1/2, 64	AMS date
OxA-183	9,340 ± 150	11,090–10,230	Charcoal	I	B2 N1/2, 62	AMS date
OxA-182	9,280 ± 150	11,080–10,180	Charcoal	I	B2 N1/2, 60	AMS date
SI 1497	9,140 ± 90	10,510–9,920	Charcoal (pooled?)	I	B2 N1/2, 59	Conventional date
SI 1500	8,910 ± 90	10,200–9,630	Charcoal (pooled?)	IIc	B1/A2, 20	Conventional date
SI 1503	8,225 ± 90	9,430–8,780	Pooled charcoal	IV	B2 N1/2, 47/48	Conventional date
SI 1501	8,175 ± 95	9,400–8,660	Charcoal (pooled?)	IIe	B1/A2, 18	Conventional date
RL 112	7,730 ± 150	8,980–8,180	Pooled charcoal	III	B3, 82	Conventional date
GX1861	7,680 ± 280	9,250–7,880	Charcoal (pooled?)	IIe	C6, 146	Conventional date
GX1860	7,575 ± 220	8,980–7,940	Charcoal (pooled?)	IIe	B1/A2, 18	Conventional date, SD given in error as 200 in Lynch et al. (1985)
GX1451	6,610 ± 160	7,780–7,160	Pooled charcoal	III?	B6, 132	Conventional date, erroneously listed as unit 2 in Lynch et al. (1985)
AA15018	4,337 ± 55	5,040–4,630	*Phaseolus vulgaris* seed, noncarbonized	IId	B1/A2, 19	AMS date
AA10987	3,495 ± 50	3,840–3,570	*Phaseolus lunatus* seed, noncarbonized	IId?	B5, 107	AMS date
AA10988	3,325 ± 55	3,640–3,380	*P. lunatus*, seed noncarbonized	IId?	B5, 107	AMS date
AA10990	2,695 ± 55	2,880–2,500	*P. vulgaris* seed, noncarbonized	IIe	C6, 146	AMS date, erroneously given as “grid” 135 (should be “unit”)
AA10991	2,540 ± 50	2,730–2,360	*P. vulgaris* pod, noncarbonized	IIe	C6, 146	AMS date, erroneously given as “grid” 135 (should be “unit”)
AA10989	2,455 ± 50	2,700–2,340	*P. vulgaris* pod, noncarbonized	IIe?	C6, 144	AMS date
AA5468	2,430 ± 60	2,710–2,210	*P. vulgaris* seed, noncarbonized	IIe?	C6, 144	AMS date
SI 1504	2,315 ± 125	2,710–1,950	Wood firedrill hearth	IV	B2 N1/2, 47	Conventional date
OxA-110	2,150 ± 150	2,460–1,710	Wood firedrill hearth	IV	B2 N1/2, 47	AMS date
OxA-198	0 ± 100	. . .	Leather scrap	III	B3, 82	AMS date, modern

Sources. Kaplan and Lynch 1999; Lynch 1980; Lynch and Kennedy 1970; Lynch et al. 1985.
Note. AMS = accelerator mass spectrometry.

Table 2. New accelerator mass spectrometry radiocarbon dates on Complex II textiles and cordage from Guitarrero Cave

Lab no.	Radiocarbon age (^{14}C yr BP ± SD)	2σ Cal age range (yr BP)[a]	δ^{13}C (‰)	Square, unit	Structural technique	Figure
OxA-21269	10,240 ± 45	12,130–11,800	−11.1	C6, 159B	Two-ply, S-spun, Z-twist cord	3*A*
OxA-21268	10,230 ± 45	12,110–11,770	−11.5	C6, 159A	Square-knotted leaves	3*C*
AA81783	9,813 ± 70	11,400–11,090	−14.2	C6, 159B	Two-ply, S-spun, Z-twist cord	3*B*
AA81781	9,797 ± 59	11,330–11,100	−12.1	C6, 156	Close twining, Z-twist wefts	2*B*
AA81782	9,767 ± 58	11,280–11,080	−27.9	C6, 159	Open twining, Z-twist wefts	2*C*
AA81780	2,210 ± 38	2,310–2,040	−13.0	C5, 124	Spiral interlinking	2*A*

[a] Where multiple intercepts exist for calibrated dates, only the age ranges associated with a probability greater than 90% are provided.

Form. The fragment's small size makes it difficult to be sure, but the elastic nature of the weave and analogy to more recent archaeological and ethnographic examples suggest that it may have been part of a flexible bag or, less likely, an item of clothing (cf. d'Harcourt 1962; Engel 1963; Grieder et al. 1988).

Close Simple Twining, Z-Twist Wefts (*Fig. 2*B)

Provenience. Complex IIb, square C6, unit 156.

Technique and comments. This fragile, charred textile fragment, executed in close simple twining with Z-twist wefts, is 1.3 cm long by 0.9 cm wide and 2 mm thick. Both warp and weft yarns are two-ply, S-spun, final Z-twist yarns of Agavaceae/Bromeliaceae fiber. There are 3 warp rows/0.5 cm, and warp elements average 1.2 mm in diameter (range 1.1–1.3 mm). Weft rows are tightly packed with 4 rows/0.5 cm. Weft elements average 1.1 mm (range 1.0–1.2). Some pinching of weft rows at one end of the fragment suggests warp-element splicing to increase fabric width and may indicate the start of the fabric or an effort to shape it. There is no diagnostic wear or adherent residue beyond soil matrix.

Form. Size makes accurate identification of form difficult, but given the prevalence of twined fabrics used for bags and clothing in the later archaeology of the Andes, both functions seem possible (cf. Bird 1985; d'Harcourt 1962; Doyon-Bernard 1990; Engel 1963; Grieder et al. 1988).

Open Simple Twining, Z-Twist Wefts (*Fig. 2*C)

Provenience. Complex IIa, square C6, unit 159.

Technique and comments. The example of open simple Z-twist weft twining consists of one large fragment measuring 3.3 cm long by 2.8 cm wide and 3.5 mm thick and a second partial weft row fragment 2 cm long by 7 mm wide and 3 mm thick (which was sampled for AMS dating). There are 3.5 warp rows/cm and 2 weft rows/cm. The gap between weft rows averages 2.7 mm (range 2.3–3.0 mm). Warp elements are composed of two loosely Z-twisted rushlike stems (Cyperaceae, cf. *Schoenoplectus* spp.), possibly longitudinally cut, that average 2.5 mm in diameter (range 2.1–2.8 mm). Weft elements are whole untwisted rushlike stems 2.1 mm in diameter (range 1.9–2.4 mm). Both faces exhibit a pronounced unidentified grimy black residue, but it is most obvious on one face (fig. 2*C*). Both faces also exhibit consistent use-related attrition on the high points of weft elements, but wear and polish from use are most visible on the face opposite that bearing the heaviest residue (see fig. A1 in CA+ online supplement A).

Form. The technique and raw material of this specimen greatly resembles examples of matting widely used throughout the Americas for floor and wall coverings, bedding, mortuary wrappings, and containers. Although use as a semirigid basketry container cannot be ruled out, matting seems a more likely form and function, given the consistent abrasive-use wear visible on both surfaces and the abundance of rush matting from other preceramic Peruvian sites with exceptional preservation (cf. Bird 1985; Engel 1963; Vallejos 1988).

Two-Ply, S-Spun, Z-Twist Cordage

Provenience. Complex IIa, square C6, unit 159B.

Technique and comments. The specimen depicted in figure 3*A*, one of multiple cords from this provenience, was designated cord *B* during reanalysis. It is a well-preserved and tightly twisted piece of cordage created by taking a bunch of Agavaceae/Bromeliaceae fibers and first S-twisting them. This cord is then folded on itself 180°, and the two halves are then Z-twisted together to make a slightly rat-tailed (tapering) final product that is 8.1 cm long. The cord's diameter averages 1.5 mm (range 1.4–1.6 mm), and its constituent plies have a mean diameter of 0.9 mm (range 0.8–0.9 mm). There are 3 twists/cm (range 3.0–3.5) and no clear evidence of use wear or residue.

The specimen designated cord *A*, shown in figure 3*B*, is a length of two-ply, S-spun, Z-twist Agavaceae/Bromeliaceae fiber exhibiting some rat tailing. It is in excellent preservation and is still springy. When relaxed, it is bent into an asymmetrical U shape 3.4 cm by 2.3 cm, but when pulled taut it is 6.4 cm long. It is tightly twisted and exhibits 9.5 twists/cm (range 9.0–10.0). The cord's diameter averages 0.9 mm (range 0.7–1.1 mm), while its individual plies average 0.6 mm di-

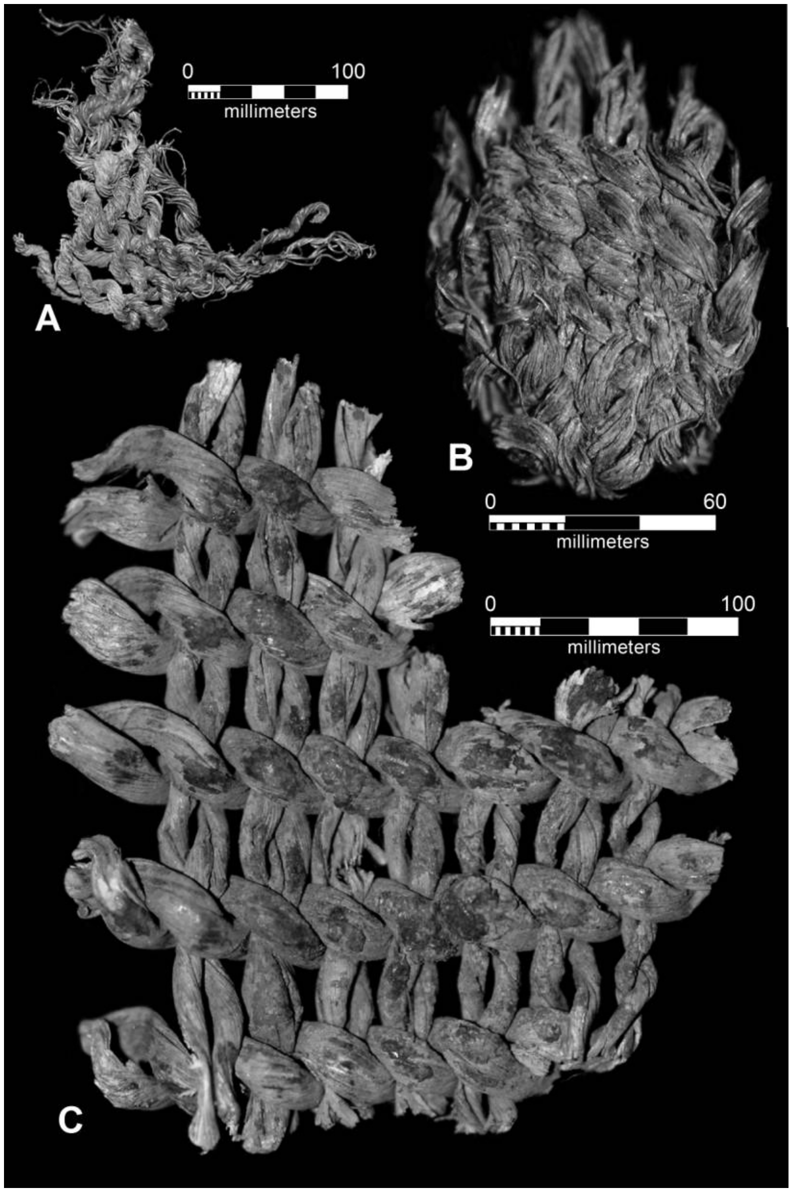

Figure 2. Accelerator mass spectrometry–dated textiles from Complex II at Guitarrero Cave. *A*, Intrusive fragment of spirally interlinked fabric. *B*, Partially carbonized fragment of a close-twined bag or cloth. *C*, Open-twined mat or basket showing organic residue. For *B* and *C*, warps are vertical and wefts are horizontal. A color version of this figure is available in the online edition of *Current Anthropology*.

ameter (range 0.4–0.7 mm). It exhibits no knots, residues, wear, or obvious splices.

Square-Knotted Leaves (*Fig. 3*C)

Provenience. Complex IIa, square C6, unit 159A.

Technique and comments. This construction, designated *A* to distinguish it from other perishables from the same provenience assignment, is composed of two slightly Z-twisted lengths of apparently unmodified Agavaceae/Bromeliaceae leaves tied to each other in a square knot that is 1.2 cm long. The entire piece, measuring 3.7 cm long by 2.9 cm wide and 9 mm thick, is hemispherical in plan, which suggests that it may have been a tie securing an object or a bundle of material. The leaves average 3.3 mm wide (range 2.0–4.9 mm). Three

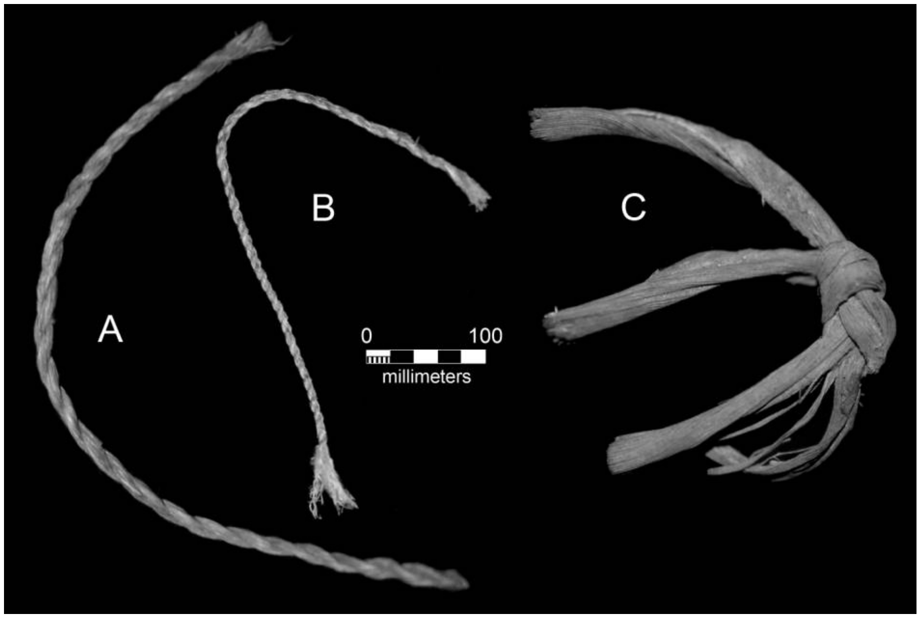

Figure 3. Accelerator mass spectrometry–dated cordage from Complex II. *A*, Two-ply cord of medium diameter. *B*, Two-ply cord of small diameter. *C*, Two slightly twisted probable Bromeliaceae leaves tied in a square knot. A color version of this figure is available in the online edition of *Current Anthropology*.

of the two leaves' four "free" ends appear slightly singed. This object lacks diagnostic wear or residue beyond adhering soil matrix.

Evidence for Fiber Artifact Production

The Complex II fiber-artifact inventory included four coils and two bundles of processed plant material interpreted as fiber-artifact construction material based on appearance (Adovasio and Maslowski 1980). The coils of fiber, for example, are thin, delicate strips (average width 2.9 mm; range 1.8–3.8 mm) that appear to be bark from an unidentified woody plant that was neatly and purposefully coiled for some future use (fig. 4). The largest, if it were unfurled, we estimate to be 18 cm long. Considered with its neatly coiled presentation, this mitigates against any interpretation of its being accidental or simply debris from reductive artifact manufacture.

The argument for on-site fiber processing and artifact manufacture during the Late Pleistocene/Early Holocene is further strengthened by observations on Guitarrero's macrobotanical remains. Smith (1980*a*), in describing the plant material, was astounded by the quantities of partially processed Bromeliad leaves and waste he encountered from the earliest through the latest deposits. So abundant was this material that he posited Guitarrero Cave as a favored site for fiber processing, if not weaving as well. Although the remains were not quantified, Smith notes that Bromeliaceae dominate the earliest assemblages, making them the most likely raw material source for Complex II leaf-fiber-based artifacts. Members of Agavaceae are present in the cave's deposits and increase in popularity as a fiber source with time. Local species of Agavaceae and Bromeliaceae, which apparently have few other cultural uses, can both be found in the immediate vicinity of the site today, and it is highly probable that they were readily available during the Late Pleistocene/Early Holocene (Smith 1980*a*, 1980*b*).

A different situation obtains for Cyperaceae species such as *Schoenoplectus* spp., a likely identification for the plant used to make the open-twined textile. This plant does not grow near the cave today but rather in the swampy margins of lakes found at much lower and higher elevations. Species of Cyperaceae are noticeably absent in the macrobotanical remains from Guitarrero but are represented in pollen samples (Kautz 1980; Smith 1980*a*). These combined paleoethnobotanical and artifactual data suggest that human visitors probably brought matting with them and manufactured it at its collection site or elsewhere far from the cave.

The Revised Guitarrero Cave Chronology

Previous studies led to the accumulation of 39 radiocarbon dates on charcoal, artifacts, and domesticates from throughout Guitarrero Cave's deposits. We present all of these dates in table 1 to correct several published errors, apply isotopic correction, and provide calendar calibrations according to

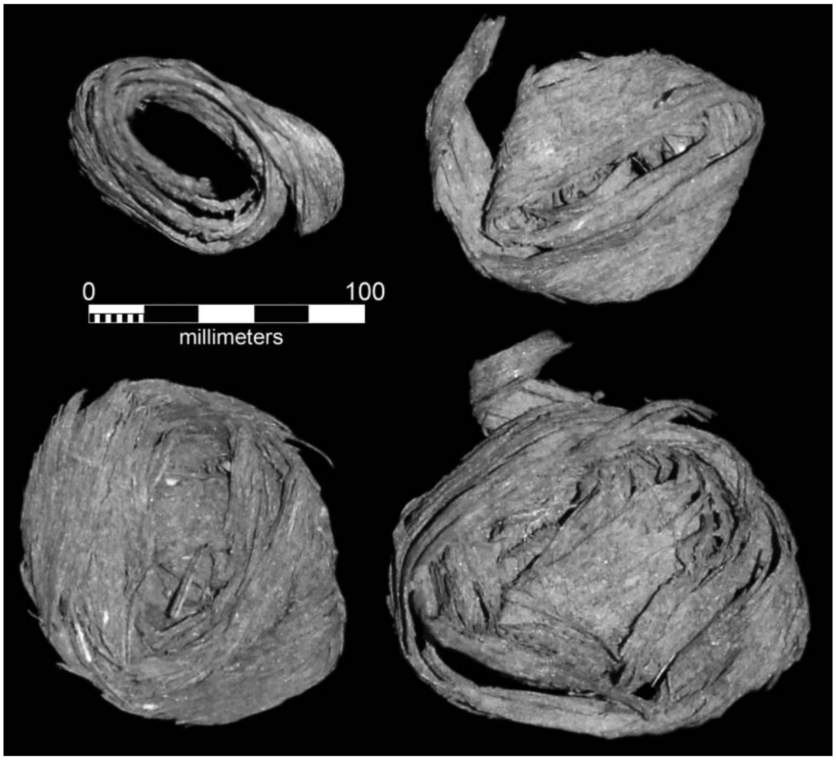

Figure 4. Examples of four bark-fiber-like raw material coils recovered from square C6, unit 156. This provenience yielded the close-twined textile fragment and indicates that these should date between 11,330 and 11,000 cal yr BP. A color version of this figure is available in the online edition of *Current Anthropology*.

current correction curves. For all of the dates presented in table 1, the full 2σ probability range is given according to the appropriate IntCal09 or ShCal04 calibration curve (Bronk Ramsey 2009; McCormac et al. 2004; Reimer et al. 2009). Only some of the previous dates were corrected for isotopic fractionation during radiometric analysis (Kaplan and Lynch 1999), and as a result, the conventional ages of at least some earlier dates are too young (Browman 1981). Although Oxford attempted to correct their dates in the 1980s by assuming a $\delta^{13}C$ of $-25‰$ (Gillespie et al. 1985), our reanalyses of Complex II cordage indicate exclusive use of Agavaceae/Bromeliaceae fiber as a raw material, though with variation in degree of fiber processing. Recent isotopic measurements of such cords demonstrate a $\delta^{13}C$ range of $-11‰$ to $-14‰$ (table 2). Further, because the measurements being made at Oxford then were $^{14}C/^{13}C$ ratio (Gillespie et al. 1985), the isotopic correction need only be roughly half of that for labs using the $^{14}C/^{12}C$ ratio. Following Browman (1981), we have added 105 years to the previously reported conventional ages for the two determinations (OxA-196 and OxA-197; Lynch et al. 1985) that we can be confident were run on Agavaceae/Bromeliaceae cordage (table 1).

The revised Guitarrero Cave radiocarbon chronology has several implications for stratigraphic interpretation and the ages of associated artifacts. First, excluding determinations on charcoal with the potential to overestimate age, the 2σ ranges for the earliest dates on cultural materials overlap with one or more of the recently acquired dates. The greater precision of the new dates, however, facilitates refinement of the earliest occupation to 12,100–11,800 cal yr BP. Second, comparison among radiocarbon dates and intrasite provenience demonstrates that artifactual material from Complexes I and II*a–c* should be considered as a single group or complex (fig. 5). This combined early complex evidences initial site use by 12,100 cal yr BP but suggests that the bulk of the cultural material derives from several probably brief site visits dating between ~11,300 and 10,300 cal yr BP. One implication of this is that the early Archaic occupation of Guitarrero Cave was short. Complex I, found only in the rear of the cave, had been dampened by groundwater, and most organic matter, apart from some fragments of bone, was destroyed. Consideration of the revised site chronology suggests that the Complex I lithic artifacts are essentially contemporaneous with the lithic and organic artifacts found in the dry lower layers of Complex II toward the front of the cave. Given that both Complex I and Complex II yielded early Archaic projectile

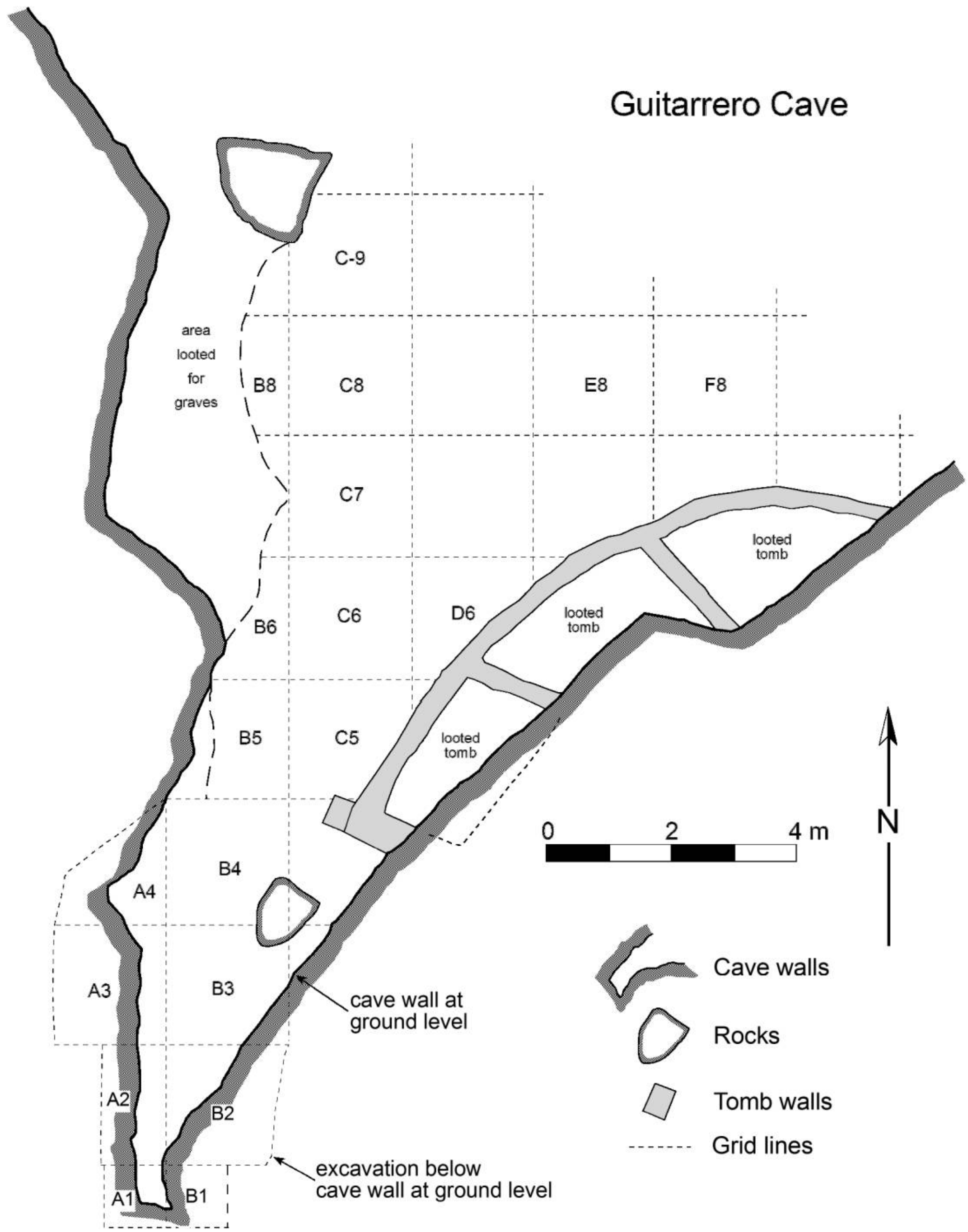

Figure 5. Planview map of Guitarrero Cave showing location of excavation squares and much younger tombs.

point types and that the Complex I industry is small and not demonstrably different from that of Complex II, this is the most economical interpretation. It remains true, however, that there was no direct stratigraphic connection between Complex I and Complex II.

By extension, spatial discrepancies in the dates from some squares and units (excavation levels) reaffirm that considerable stratigraphic disturbance from rodents and human digging (i.e., ancient mortuary practices) have disturbed some areas of the cave more than others. Based on available dates, the Late Pleistocene/Early Holocene levels of square C6 appear intact despite their proximity to later burial tombs. Conversely, the fragment of spiral interlinking that direct dating demonstrates is out of stratigraphic sequence derives from square C5, which is intruded upon by tomb construction. Other squares that appear to evidence stratigraphic integrity in their lowest deposits based on radiometric assays are B1 and B2.

Perishable Technology and the Peopling of the Andes

In their hemispheric context, the Guitarrero textiles constitute the oldest examples of their technologies from South America and are among the earliest from all of the Americas. The next oldest firmly dated textiles from South America derive from Paloma, Peru, and were dated as early as 8,800 cal yr BP, where technologically similar cordage, netting, bags, twined matting, and clothing made from plant fibers were recovered with burials (Vallejos 1988). Older vegetal cordage and cordage impressions dating to ~14,500 cal yr BP were recovered from Monte Verde, Chile (Adovasio 1997). These cords have not been directly dated, but the wooden pegs around which several are knotted have been directly dated. Fragments of knotted cords, possibly from nets, from Quebrada Jaguay, Peru, date to about ~10,600 cal yr BP (Sandweiss et al. 1998). Small fish bones, including drum at Quebrada Jaguay as well as anchovy and marine bird bones dated to ~12,500 cal yr BP at Quebrada Tacahuay, Peru (deFrance 2005; deFrance et al. 2001; Keefer et al. 1998), further imply the existence of early and sophisticated netting technology in coastal Peru.

Guitarrero Cave now provides some of the best evidence for early Andean occupation not confounded by ambiguous artifacts or dating concerns. These data corroborate existing models of the timing of early highland colonization that when viewed in concert with paleoclimatic reconstructions see minimal human penetration into the highlands until after 12,000 cal yr BP (Aldenderfer 1998, 1999, 2008; Núñez, Grosjean, and Cartajena 2002). In these models, Late Pleistocene foragers occupied lower-elevation settlements and engaged in periodic forays to the highlands for nearly 2,000 years. Following deglaciation of the Andes and possibly amelioration of the Younger Dryas climatic reversal by 11,500 cal yr BP, humans rapidly colonized higher elevations while pursuing fauna and flora undergoing adaptive radiation (Aldenderfer 1998, 1999; Lynch 1998; Rodbell, Smith, and Mark 2009; Stansell et al. 2010). Accordingly, the occupational lag between the lowlands and highlands is perceived as a product of low initial human population densities, vertically shifting faunal and floral regimes in response to climatic change, and the time necessary for people to familiarize themselves with a new landscape. Guitarrero Cave's location at a lower elevation in a more temperate environment as compared with the high Andean altiplano made it an ideal site for humans to camp and provision themselves for excursions to even higher altitudes.

Early Weavers in the Andes

Environmental and biological consequences of high-altitude living posed serious challenges to human settlement of the highlands. For these reasons, researchers have assumed that early high-elevation use was logistically organized from lower-elevation camps and that foraging groups were exclusively male (Aldenderfer 1999, 2008). Clothing was the critical cultural adaptation that allowed humans to survive cold temperatures and settle higher elevations (Aldenderfer 2006). Abundant stone scrapers at highland sites such as those in the Callejón de Huaylas and Asana suggest hide working to manufacture clothing. An increase in such tools at 10,500 cal yr BP has been interpreted as indicating female participation coincident with a shift to more permanent settlement (Aldenderfer 1998; Lynch 1971, 1990). The age and technical execution of the Guitarrero textiles and cordage show the existence of a developed plant-fiber-based technology complementary to the production of hide clothing as well as gear for transport, trapping, hunting, and cooking.

Archaeological and ethnographic cross-cultural data indicate that textile manufacture is a strongly gendered craft that is usually the domain of women (Adovasio, Soffer, and Page 2007; Murdock and Provost 1973; Weiner and Schneider 1989). The existence of Late Pleistocene/Early Holocene fiber-based artifacts, construction materials, and production debris at Guitarrero Cave does not unequivocally establish women's presence among early Andean foraging groups but greatly strengthens such a possibility. Given the detrimental effects of altitude on female reproductive health, women's participation in the earliest highland foraging trips probably facilitated biological adaptation to physiological stressors that made possible rapid permanent settlement by 10,500 cal yr BP. The Guitarrero Cave perishable artifact assemblage thus demonstrates the antiquity of sophisticated perishable technologies and underscores their role in the successful human colonization of high altitudes and the Americas (Adovasio, Soffer, and Page 2007).

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(Current Anthropology, vol. 52, no. 2, p. 285)

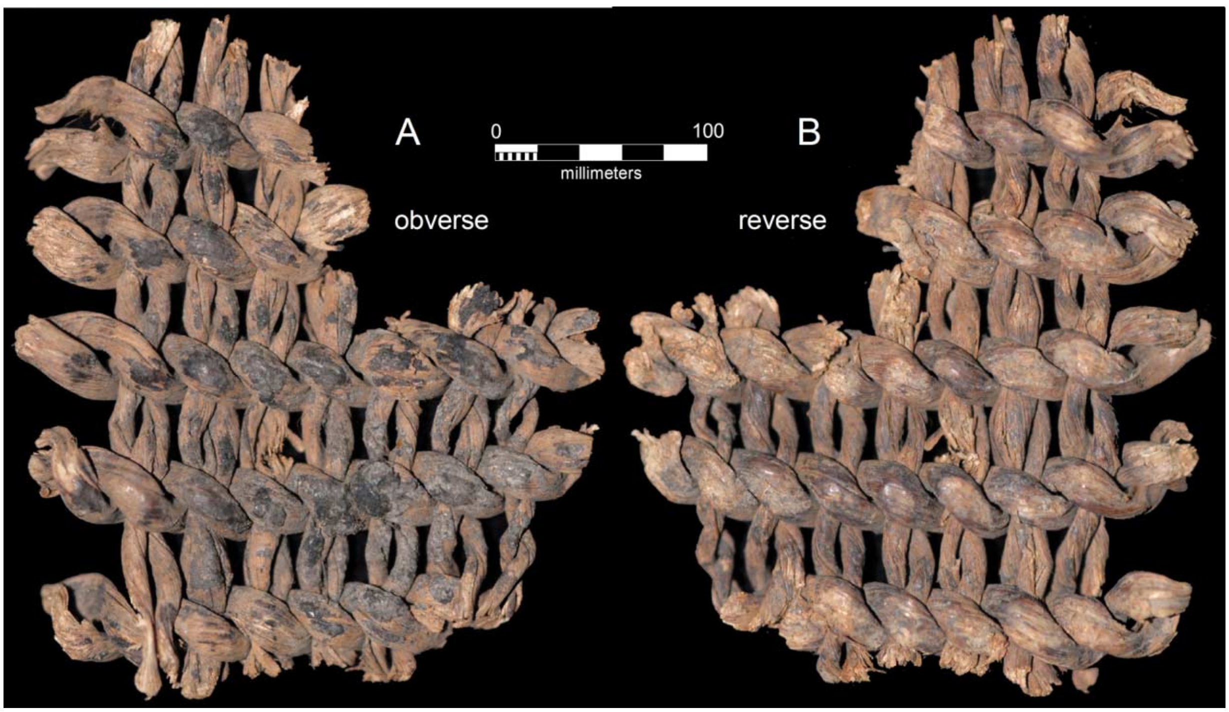

Figure A1. Both sides of a fragment of a twined mat or basket container AMS dated to about 11,200 cal yr BP. Black grimy residue (*left*) and wear from use (*right*) are visible.