The origins of urban life and functioning states are two of the most fascinating research problems in anthropological archeology and a topic that has intrigued generations of scholars working on the Peruvian north coast. In this region, Andeanists have documented the rise of Moche as a dominant culture during the first millennium A.D., and the emergence of urban life and stately institutions at this society’s principal center. Although there is a broad consensus that Moche represents an archaic state, it is still unclear whether it is an example of primary state formation or a case of a second-generation state. To document this question, archaeological excavations were recently carried out at the Gallinazo Group site in the Virú Valley. Results from a radiocarbon dating program indicate that a functioning state probably emerged in this valley during the second century B.C., possibly preceding Moche by a few centuries. These results necessarily raise question regarding the nature of state development on the north coast of Peru and, in particular, whether there was a single center of state development in this region or multiple sites where similar conditions and processes led to the parallel emergence of functioning states.

state development | Andes | Gallinazo Group | radiocarbon dating

The Moche capital was built on the southern margin of the Moche Valley, a few kilometers away from the present city of Trujillo (Fig. 1), and featured a large residential sector laid out in an orthogonal grid plan with habitation compounds of varying size and quality as well as workshops (14–18). The residential sector is framed between two large buildings used for civic and ceremonial activities, including public gathering and human sacrifice (19–21). Recent work at the site indicates that the settlement was occupied by the second century A.D., and that it experienced a seemingly continuous urban growth until it was abandoned during the eighth century (15, 16, 20, 22). This city was the paramount center of a complex settlement system in the Moche Valley, which featured a four-tiered administrative hierarchy engaged in the centralized management of irrigation, trade, and defense (13).

Although the nature of Huacas de Moche’s political influence is still debated, evidence indicates that it developed into a multivaley expansionist state around A.D. 300 (10, 13, 15, 23–29). In recent years, Andeanists have offered a number of explanations for the spread of Moche art and architecture, which range from two or more independent polities that ruled over contiguous territories (30, 31) to a constellation of political entities spread along the littoral, marked by periodic alliance of contending government systems that shared a common cultural tradition (13, 23, 32–35).

Although there is a broad consensus that Huacas de Moche was the seat of an early archaic state, it is still unclear whether this represents a case of primary state formation (first-generation state)—in which stately institutions emerged in a “context of nonstate societies, without contact with other preexisting states” (1)—or an example of second- or third-generation state. Likewise, the question remains whether there was a single center of state development along the Peruvian north coast or multiple sites where similar conditions and processes led to the parallel emergence of functioning states. In his review of the origin of state societies in South America, Stanish (10) came to the conclusion that not one but three states (Moche, Wari, and Tiwanaku) independently emerged in the Andean region during the first half of the first millennium A.D., leading him to question the very notion of pristine state development. Similarly, Billman (13) noted that the debate has now shifted from whether Moche society had developed a functioning state to how many concurrent Moche states emerged along the north coast of Peru during the Early Intermediate period.

In a provoking study conducted a few years earlier, Fogel (36) posited that in fact Moche leaders had merely built upon existing political institutions, and that the emergence of the Andean state took place at an earlier time, in the Virú Valley (Fig. 2). Here, she argued, the Virú (Gallinazo) polity had developed a number of institutions typical of functioning states, including a complex...
sity in the valley and how Virú administrators coped by extending the cultivated area to sectors that were previously unoccupied. This was achieved by expanding the existing irrigation canal system, and creating intakes high-up in the middle valley. Willey also showed how Virú leaders were successful at creating a unified valley command over the entire area, materialized through the construction of a four-tiered settlement system, including an urban center of exceptional dimensions (the Gallinazo Group), middens or defensive settlements, villages, and hamlets.

To test Willey’s model, in 2002 the author, together with Peruvian and Canadian colleagues, initiated fieldwork at Huaca Santa Clara—a midsized administrative settlement built by members of the Virú polity on the flanks of a small hill that dominates the center of the valley floor. Excavations led to the discovery of an imposing system of storage facilities on the hill-sides, as well as moderate-sized civic buildings perched on the hilltop and lower ridges (43). Radiocarbon dates obtained from this site range from 2010 ± 50 B.P. to 1350 ± 60 B.P., indicating that this center was occupied for a relatively long period between the second century B.C. and the eighth century A.D. The available evidence also suggested that Huaca Santa Clara functioned as an important node in Virú’s valley-wide administrative network, which included other midsized settlements, four of which formed a unified system of fortification at the valley neck (44)—the only entry point from the highlands, and an area where major irrigation canal intakes are located.

Virú’s principal center was undoubtedly the Gallinazo Group: a concentration of mounds located on the north side of the river in the lower valley, built through the accumulation and subsequent erosion of material deposited by hundreds of years of human occupation. Of the 30 mounds that feature Virú’s corporate ceramic type (Gallinazo Negative), only six present civic architecture, whereas the others essentially represent raised habitation platforms of varying sizes. Work at this site was initiated by Bennett (40), whose sizable excavations brought about a wealth of information on this polity’s capital, exposing compact networks of room units arranged in honeycomb patterns and hinting at a long and sustained occupational history. Despite the general significance of the Gallinazo Group site, the primary center of this polity at the time and most likely the seat of regional leadership.

Research on the polity that ruled over the Virú Valley during the Early Intermediate period was initiated during the first part of the 20th century by Bennett (39, 40), Larco Hoyle (41), and Willey (42). The Virú polity’s occupation of the valley was marked by the emergence of a distinctive type of pottery (Gallinazo Negative) adorned with negative-resist painted designs. The distribution of this corporate style ceramic on settlements throughout the valley floor provided archaeologists with an opportunity to study this society’s hold on the land and people and to undertake a reconstruction of its complex history.

As part of the Virú Valley Program, Willey (42) undertook a vast study of settlement patterns and convincingly showed how, during this period, prehistoric population size reached its maximum in the valley and how Virú administrators coped by extending the cultivated area to sectors that were previously unused—including the lands surrounding the Gallinazo Group.

This archaeological culture was traditionally referred to as Gallinazo, but this term is problematic (38), as it has been used to describe two ceramic ensembles: utilitarian incised and appliquéd pottery (Castillo Incised and Modeled wares) and Gallinazo Negative fine ware. Incised and appliquéd pottery are found in every valleys of the Peruvian north coast, from Casma to Piura, and throughout the sequence of at least certain regions where sufficient research has been done. Gallinazo Negative, on the other hand, is essentially a corporate style largely restricted to the Virú Valley.

This paper seeks to shed light on this problem by presenting unique data on the chronology of the Gallinazo Group site, the primary center of the Virú Valley at the time and most likely the seat of regional leadership.

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extremely well preserved under a thin layer of adobe dust. This imposing structure is made up of a combination of in-filled chambers and building columns made of thousands of piled adobes set one against another—a construction technique that was common on Moche sites (45). It is dominated by towering platform and an adjacent terrace (Southern Terrace) that fronts a wide plaza—presumably used for large public gatherings and ceremonial activities. This architectural pattern (stage-like platform fronting plaza) was also popular on Moche sites (46).

The Group is of exceptional dimensions, with mounds spread over an area of ∼600 ha of flatlands, although the total occupied area of the mounds was only ∼40 ha. Population estimation is complex, considering that the Group’s urbanscape featured a dense residential environment made up of thousands of small rooms crammed together in an agglutinative manner. Using indices developed for other agglutinated settlements (47, 48) results in population size ranging from 14,400–28,800 people, depending on how much of the total space was occupied by residences at any one time.‡

In sum, the Early Intermediate period in Virú was marked by important social (increase in population size), economic (increased production capacity), and political (creation of a unified valley command) transformations, archaeologically visible through a number of material correlates. These include an increase in the overall number of settlements in the valley, the extension of the total area under cultivation, the construction of new irrigation canals, and the establishment of a four-tiered administrative system—in which subsidiary centers were involved in the day-to-day management of resources and defense against competing neighboring polities—as well as a large and densely populated agglomeration, featuring an imposing civic building presumably used for large public gatherings. These data are interesting from the point of view of primary state formation research, since they seem to support Fogel’s hypothesis that Virú leaders successfully developed institutions traditionally associated with archaic states, and that their political capital was an urban settlement. This raises a number of questions, including ones regarding the nature of early statecraft in this region of the world (first- vs. second-generation state; single or multiple centers of development). Until the chronology of this polity’s hold on the Virú Valley is established, however, any further discussion will remain conjectural. The second part of this paper presents results from a program of radiocarbon dating conducted by the author at Huaca Gallinazo since 2008, which was aimed at re-establishing the chronology of this key site in Andean prehistory.

Results

Over the course of the last two field seasons, one of the main objectives of our work at Huaca Gallinazo was to obtain samples of organic material from different occupation levels for radiocarbon dating. Exploratory trenches were excavated through stratified deposits, and open-area excavations were also undertaken to study the late occupation levels—sections of whole rooms were opened while maintaining bulk walls along at least two sides of the trenches to ensure stratigraphic control. We also cleaned part of an immense looting trench on the tall adobe platform that dominates Huaca Gallinazo to document the construction of this civic building. These excavations offered a wealth of “short-life” organic material suitable for radiocarbon dating, and the opportunity to monitor change in material culture through time. Samples for radiocarbon dating were collected from 10 excavation units in the residential sector and on

‡These population estimates are very much in line with those for the capital of another primary state, Monte Albán in Mexico’s Oaxaca Valley. According to Blanton (49), the population estimate of Monte Albán is 10,200–20,400 during the Late Monte Albán I phase (300–100 B.C.), which Spencer and Redmond (1) and others have argued is when the Monte Albán state formed.
Fig. 3. 3D model and photograph of the central mounds of the Gallinazo Group.

and around the civic complex (Fig. 4, U-1 to U-10). The analytical data for the 20 samples analyzed are reported in Table S1. Five dates were obtained through radiometric analysis, while the others were analyzed through accelerator mass spectrometry.

**Residential Sector.** Fourteen radiocarbon dates were obtained from the residential sector. In this area, excavations were carried out in deep test pits and in open areas. In all excavation units, the ceramic assemblage included utilitarian wares (dominated by Valley Plain, Castillo Plain, Castillo Incised, and Castillo Modeled), as well as fragments of Gallinazo Negative decorated pottery.

Previous excavations were carried out through the site’s deep stratified deposits (40, 50), revealing an uninterrupted occupation that would have spanned centuries, but until recently no absolute chronology was available to date the occupation of Huaca Gallinazo. Two deep stratigraphic test pits were excavated with the objective to obtain a terminus ante quem for the occupation of the site. For work safety reasons, however, we could not reach the deepest strata in either of these units. The first test pit (U-1) was excavated through the floor of a small storage chamber and reached a depth close to 5 m. Four clay floors and six refuse layers were identified. Although organic material was present in each stratum, only two samples were retained for analysis. Those samples are from the fills below floor 1 (Beta-253100: 1720 ± 40 B.P.) and floor 2 (Beta-253101: 1860 ± 40 B.P.). The second test pit (U-2) was unusual in that we reopened an early archaeological trench (Strong and Evans’ Strata Cut I), enlarging it by 50 cm toward the east and sampling each layer. Five samples were analyzed; they come from the layers of fill below floor 1 (Beta-233868: 1680 ± 40 B.P.), floor 2 (Beta-233867: 1900 ± 70 B.P.), floor 3 (Beta-233866: 1960 ± 50 B.P.), floor 4 (Beta-233865: 1870 ± 60 B.P.), and floor 5 (Beta-233864: 1720 ± 40 B.P.).

Results from these test pits therefore indicate that the residential sector at Huaca Gallinazo could have been occupied by 50 B.C. in calibrated age, although the earliest occupation levels have not yet been reached.

Open-area excavations were also carried out in the residential sector. The first unit (U-3) was a large patio (∼9.5 × 10.5 m) in the center of an architectural compound. Here we identified the remains of four successive clay floors. Samples of organic material were collected below the third (Beta-253104: 1750 ± 40 B.P.) and fourth (Beta-253105: 1820 ± 40 B.P.) floors. Two human burials were also uncovered: an adult female and a child less than two years old. The corpses were wrapped inside shrouds reinforced with wood twigs. When analyzed, the twigs from both burials yielded coeval conventional radiocarbon ages (Beta-253102: 1650 ± 40 B.P.; Beta 253103: 1660 ± 40 B.P.). The second living space (U-4) was a large rectangular room (∼4 × 14 m) immediately to the north of Bennett’s V-59A excavations (40). It featured a sequence of eight distinct layers of refuse which covered an uneven clay floor at ∼2 m below the present surface. On the floor we uncovered a hearth, which was sampled and analyzed (Beta-233871: 1820 ± 40 B.P.).

The other two units excavated in this sector (U-5 and U-6) were small size (∼160 × 160 cm) chambers, featuring storage jars set within the clay floor. Samples were collected from the layer below the first clay floor in each chamber. Because of the shallowness of the deposits (the samples were collected less than 1 m below the present surface), we posited that the samples would date the terminal occupation of the site. The two samples analyzed produced relatively late conventional ages (Beta-233869: 1550 ± 70 B.P.; Beta-233870: 1540 ± 70 B.P.), suggesting that the residential sector could have been occupied until as late as A.D. 650, based on the calibration of these dates using two-sigma statistics (95%).

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8One test pit excavated at Huaca Gallinazo (Strata Cut 1) reached a depth of more than 7 m, revealing layer upon layer of habitation levels (50).

9This last date is unreliable in view of its departure from the temporal pattern shown by the others in this sequence (floors 1–4), where the 2-sigma calibrated estimates range back to the first century B.C.

10All calendar calibrations reported here are expressed with two sigma statistics (95%).
Civic Building. Four units were excavated on and around the civic building that dominates Huaca Gallinazo. A deep test pit (U-7) was excavated near the northwest corner of the building to date the initial construction phases. Following the exterior facade of the adobe structure, we reached a depth of 5.5 m below the present surface, identifying five successive occupation floors abutting the facade. Samples of organic material were collected from the layers of fill below floor 2 (Beta-253106: 1750 ± 40 B.P.), floor 4 (Beta-253107: 1780 ± 40 B.P.), and floor 5 (Beta-253108: 1880 ± 40 B.P.). The results indicate that the civic complex was built early in the site’s history, possibly around A.D. 50, although the earliest occupation levels have not yet been reached.

Two more dates came from excavation carried out on a high terrace located on top of the civic building (Southern Terrace), which features a network of rooms of varying sizes. Excavations in Unit 8 exposed a rectangular chamber with three successive clay floors and refuse layers. A piece of cane from the fill below floor 1 was sampled and analyzed (Beta-260854: 1730 ± 40 B.P.). A common bean (Phaseolus vulgaris) from a small storage room (U-9) was also analyzed (Beta-253109: 1690 ± 40 B.P.). These two samples came from what was likely the penultimate occupation level of the Southern Terrace, and therefore provide a terminus post quem for the abandonment of the civic building.

The last excavation unit (U-10) was designed to study the towering platform that dominates the civic building by cleaning a section of a large looter’s pit. Rubble was cleared on a 4-m wide section, revealing the building sequence. Toward the bottom of the profile, a layer of charred material that marked a clear break in the construction sequence was sampled and analyzed (Beta-260852: 1720 ± 40 B.P.). Above this stratum, the profile shows at least two more building phases, each of which increased the platform height using a combination of loose fill material and adobe building columns.

The three radiocarbon dates obtained from the top of the civic building are roughly coeval, ranging between A.D. 230 and 420 in calendar years. The fact that the sample from the bottom of the profile in Unit 10 is contemporaneous with the ones from the near-terminal occupation of the Southern Terrace can be explained by the general construction sequence. Although it cannot be established that these samples come from stratigraphically contemporaneous layers, they come from strata located essentially at the same elevation above mean sea level (between 32.84 and 33.22 m). Based on preliminary analyses, it seems likely that the Southern Terrace originally extended further north, and that the towering adobe platform was a late addition to the building.

Discussion

These radiocarbon dates provide strong evidence for a long and uninterrupted occupation of both civic and residential sectors at Huaca Gallinazo, indicating that the site could have been occupied from as early as the first century B.C. until as late as the seventh century A.D. (Fig. 5). These results take into account the full range of the two-sigma statistics, however, something that necessarily stretches the calibrated ranges. The present evidence nevertheless strongly supports the idea that the Gallinazo Group was occupied throughout the first half of the millennium A.D. and that the founding of the settlement occurred at an even earlier date. Indeed, based on information gathered during our survey, we evaluate that there are at least 3 m of occupation deposits below the deepest sample analyzed, which could represent more than 100 years of refuse deposition and construction fill. It seems reasonable to posit that Huaca Gallinazo was first occupied sometime during the second century B.C. This would agree with results obtained previously at the mid-sized Virú administrative center of Huaca Santa Clara, where the earliest sample analyzed also suggested a possible founding date in the second century B.C. (33).

These results are significant in view of primary state formation research on the Peruvian north coast. Not only do they provide important information on the occupation of the Gallinazo Group site, but also help to establish the chronology of the Virú polity’s hold on the valley. Indeed, according to Willey (42) the founding of the Group was closely related to the extension of the cultivated area on the northern margins of the valley, and to the massive public work required for expanding the existing irrigation canal system. Based on this scenario, the site’s construction would have marked the materialization of Virú leader’s political success and possibly the emergence of a new social order. The data obtained from this radiocarbon dating program therefore seem to substantiate Fogel’s hypothesis regarding the early formation of a regional state in Virú sometimes during the second century B.C., evidence that calls for a reevaluation of the nature of early statecraft in this region.

These results raise questions regarding the notion of pristine state development on the north coast of Peru. Based on the available chronological evidence, one could be tempted to posit that the leaders of the Virú polity were the first to take steps toward the establishment of a functioning state “without contact with other preexisting states” (1). Such a conclusion would seem premature, however, considering the large gaps that still exist in the chronology of other major settlements in this region where signs of incipient statecraft have been documented archaeologically, including at Huacas de Moche, the most important center of the post-A.D. 300 period. Indeed, although excavations in the urban sector conducted by Topic (44), Chapdelaine (51), and Uceda (22) revealed a long and uninterrupted occupation, absolute dates for the deepest occupation levels—associated with the founding of this impressive capital and possibly with the in situ crystallization of another archaic state—are not yet available. The same predicament affects earlier Moche Valley settlements where important signs of socio-political transformation have been documented archaeologically, including Cerro Arena (52) and Cerro Oreja (24).
Another, possibly more fruitful, approach for future research might be to leave the concept of pristine state development aside until more radiocarbon dates are available and instead explore the possibility that there was never a single center of state development along the Peruvian north coast but, rather, multiple centers of state development (10, 13). In a context where each coastal valley was slightly different in terms of environment, resources, access to trade routes, etc., the debate should now shift from whether Moche society developed the first state in the Andean region to how many different incipient states emerged along the Peruvian north coast in the centuries around the turn of the common era.

**Methods**

As a rule, excavation followed the site's stratigraphy, which usually features the following sequence: beaten clay floor, refuse fill, leveling fill, beaten clay floor, and so forth. All but one of the samples were from sealed stratigraphic layers (below a clay floor) to ensure the quality of the results. Moreover, all samples were "short-life" organic material (such as food remains or thatching material), reducing the chance of obtaining disproportionately early dates because of the "old wood effect." All of the samples were removed from their archaeological context by the author using clean stainless steel tools and stored directly into foil paper. In the field laboratory, each sample was inspected, placed in clean foil paper, and bagged. All samples were pretreated and analyzed by Beta Analytic Inc.** All calibrations of radiocarbon age to calendar years for Huaca Gallinazo samples are based on INTCAL04 (S3).

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41. Larco Hoyle R (1945) *The Virú Culture (Translated from Spanish)* (Sociedad Geografica Americana, Buenos Aires).
42. Willey GR (1953) *Prehistoric Settlement Patterns in the Virú Valley, Peru* (Smithsonian Institution Press, Washington, DC).

**Information on pretreatment and analytical procedures is available at Beta Analytic.**
## Supporting Information

**Millaire 10.1073/pnas.0911226107**

Table S1. Analytical data for 20 samples from Huaca Gallinazo

<table>
<thead>
<tr>
<th>Unit</th>
<th>Sample number</th>
<th>Material dated</th>
<th>Context information</th>
<th>Age B.P.</th>
<th>Calendar calibration (2σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential sector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U-1</td>
<td>Beta-253100</td>
<td>Charred material</td>
<td>PC-1, below floor 1</td>
<td>1720 ± 40</td>
<td>A.D. 230–410</td>
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<tr>
<td></td>
<td>Beta-253101</td>
<td>Charred material</td>
<td>PC-1, below floor 2</td>
<td>1860 ± 40</td>
<td>A.D. 60–240</td>
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<tr>
<td>U-2</td>
<td>Beta-233864</td>
<td>Charred material</td>
<td>Strata Cut I, below floor 5</td>
<td>1720 ± 40</td>
<td>A.D. 230–410</td>
</tr>
<tr>
<td>Beta-233865*</td>
<td>Charred material</td>
<td>Strata Cut I, below floor 4</td>
<td>1870 ± 60</td>
<td>A.D. 10–260</td>
<td>A.D. 300–310</td>
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<tr>
<td></td>
<td>Beta-233866*</td>
<td>Charred material</td>
<td>Strata Cut I, below floor 3</td>
<td>1960 ± 50</td>
<td>50 B.C.—A.D. 130</td>
</tr>
<tr>
<td></td>
<td>Beta-233867*</td>
<td>Charred material</td>
<td>Strata Cut I, below floor 2</td>
<td>1900 ± 70</td>
<td>40 B.C.—A.D. 250</td>
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<tr>
<td>U-3</td>
<td>Beta-253102</td>
<td>Wood twigs</td>
<td>CA1-A1, burial 1</td>
<td>1650 ± 40</td>
<td>A.D. 260–280</td>
</tr>
<tr>
<td></td>
<td>Beta-253103</td>
<td>Wood twigs</td>
<td>CA1-A1, burial 2</td>
<td>1660 ± 40</td>
<td>A.D. 260–290</td>
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<tr>
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<td>Beta-253104</td>
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<td>A.D. 210–290</td>
</tr>
<tr>
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<td>1820 ± 40</td>
<td>A.D. 90–260</td>
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<tr>
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<td>Beta-233871</td>
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<td>PC-5, above floor 1</td>
<td>1820 ± 40</td>
<td>A.D. 90–260</td>
</tr>
<tr>
<td></td>
<td>Beta-233869*</td>
<td>Charred material</td>
<td>PC-2, below floor 1</td>
<td>1550 ± 70</td>
<td>A.D. 290–320</td>
</tr>
<tr>
<td></td>
<td>Beta-233870*</td>
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<td>PC-4, below floor 1</td>
<td>1540 ± 70</td>
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<tr>
<td>Civic building</td>
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</tr>
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<td>U-7</td>
<td>Beta-253106</td>
<td>Charred material</td>
<td>PC-3, below floor 2</td>
<td>1750 ± 40</td>
<td>A.D. 210–390</td>
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<td>Beta-253107</td>
<td>Charred material</td>
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<td>A.D. 130–350</td>
<td>A.D. 300–460</td>
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<tr>
<td>Beta-253108</td>
<td>Charred material</td>
<td>PC-3, below floor 5</td>
<td>1880 ± 40</td>
<td>A.D. 300–460</td>
<td>A.D. 480–530</td>
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<tr>
<td>U-8</td>
<td>Beta-260854</td>
<td>Cane from roof</td>
<td>Southern Terrace, A-6, below floor 1</td>
<td>1730 ± 40</td>
<td>A.D. 230–410</td>
</tr>
<tr>
<td>U-9</td>
<td>Beta-253109</td>
<td>Common beans</td>
<td>Southern Terrace, storage room</td>
<td>1690 ± 40</td>
<td>A.D. 250–420</td>
</tr>
<tr>
<td>U-10</td>
<td>Beta-260852</td>
<td>Charred material</td>
<td>Tall Platform, looters’ pit</td>
<td>1720 ± 40</td>
<td>A.D. 230–410</td>
</tr>
</tbody>
</table>

*Analyzed using radiometric method. All other samples were analyzed through accelerator mass spectrometry.*