Supplementary Information: Quintus et al. The Scale, Nature, and Timing of Agricultural Adaptations in Upland Kaʻū

This supplement describes the construction of Bayesian models and occurrence plots used to analyze the chronology of standing infrastructure and subsurface deposits in the Kahuku Unit of Hawaiʻi Volcanoes National Park. The methods employed here were developed after those presented in Quintus et al. (2023) and Morrison et al. (2022).

Data for these models derive from 30 test pits or units across 22 features. Of the features, 13 are found in the kīpuka and the remaining nine are from the eastern pasture. The nature of Bayesian models differed depending on the event being estimated. As such, the discussion below separates between sequences of standing infrastructure and models of subsurface deposits. Stratigraphy is described in detail for subsurface deposits but not for standing infrastructure All radiocarbon dates from the irrigated facilities and colluvial slopes are provided in ST1.

Bayesian Models of Standing Infrastructure

Date estimates for the construction of standing infrastructure were calculated as sequences. As noted in the main document, radiocarbon dates were categorized as *terminus post quem* (TPQ) or *terminus ante quem* (TAQ) for each event of interest. When multiple dates were available either beneath or above an event of interest, they were grouped into a TPQ or TAQ phase. Estimated ages of construction were also used as constraints on other events of construction, either as TPQ or TAQ. This took advantage of the relative relationships between features, which are described for individual sequences. Most sequences had a single or two associated dates. As such, the majority of sequences followed a simple model similar to that present in Dye (2016):

Boundary (“Feature # Start”) > Phase (“Feature # TPQ”) > Boundary (“Feature # Construction”) > Phase (“Feature # TAQ”) > C_Date (AD 1850)

All sequences use a universal TAQ of 1850. This period corresponds to changes in land tenure and organization, which are well-documented in the project area. Each sequence is described below with reference to specific TPQs and TAQs. Polynesian-introduced species are noted in the text. For other taxa identifications, see the table of radiocarbon dates in the main text (Table 1). The model had an A_{model} of 63.3 and an $A_{overall}$ of 67.1.

A second iteration of the model was run using an outlier model after Christen (1994) as applied in Quintus et al. (2023). This second iteration was used to assess the robustness of the original model and provide another means to evaluate the fit between individual dates and the model.

The full OxCal scripts for both model iterations, with and without outliers, are provided in an additional supplementary file. A comparison of the model outputs is provided in Table S1.

T1 (Linear Embankment): This feature is a kuaiwi that runs north to south (mauka-makai) across the kīpuka. It was excavated in 2017, with a single unit (TP 11), and the dates associated with the feature were reported in Quintus and Lincoln (2020). A single radiocarbon determination is available for the excavation (Beta-471147). This determination constrains one event of construction, which is the construction of the surface feature. The determination originates directly beneath the basal course of stone of the feature; it is a TPQ for the construction of the feature.

SF1. East wall of T1 in TP 11. The date from the feature was taken from beneath the basal course of stone.

T2 (Linear Embankment): This feature is a kuaiwi that runs north to south (mauka-makai) across the kīpuka. A single unit was dug into the feature (TP 6), also excavated in 2017, with the date associated with the feature reported in Quintus and Lincoln (2020). A single determination (Beta-471144) was obtained for the feature, which was taken for directly beneath the basal course of stone for the surface feature. As such, it is a TPQ for the construction of the feature.The estimated age for the construction of this feature was used to constrain the construction of T35, which abuts T2.

SF2. West wall of T2 in TP 6. The date from the feature was taken from beneath the basal course of stone.

T3 (Linear Embankment): This feature is a kuaiwi oriented in the kīpuka. The feature was excavated by the National Park Service in 2010 (TU-3) and is reported here for the first time. The single radiocarbon determination (Beta-370512) is available from this feature, which was collected from the matrices of the feature. As such, the feature represents a TPQ for the construction of the feature since the charcoal was used in the construction of the feature. The surface architecture is the only feature estimated using this determination. Images of excavation are not available as the unit was excavated by the NPS.

T6 (Linear Embankment): A single radiocarbon determination is available from this feature, which is a linear embankment that runs north and south (mauka-makai). A single unit was dug into the feature in 2017 (TP 13). Importantly, T15 abuts T6, which implies that T6 was built before T15. The single determination (Beta-471145) from T6 was obtained directly beneath the basal course of stones of the feature and reported in Quintus and Lincoln (2020). One component of construction was estimated, which was then used as a TPQ for the construction of T15.

SF3. East wall of T6 in TP 13. The date from the feature was taken from beneath the basal course of stone.

T9 (Linear Embankment): This feature is a linear embankment that runs roughly north to south, though at a slightly different angle relative to other linear embankments in the kīpuka. It is a shorter feature, abuting and connecting to another roughly N-S oriented linear embankment in a roughly V-shape. The feature was excavated using a single unit in 2023 (XU33). A single radiocarbon determination (UGAMS-65615) is available from the feature, obtained from beneath the basal course of stone that constitutes the feature. This date was reported in Quintus and Lincoln (2020). The date provides a TPQ for the construction of the feature visible on the surface.

SF4. Overview of T9 looking toward the south in XU33. The date from the feature was taken from beneath the basal course of stone.

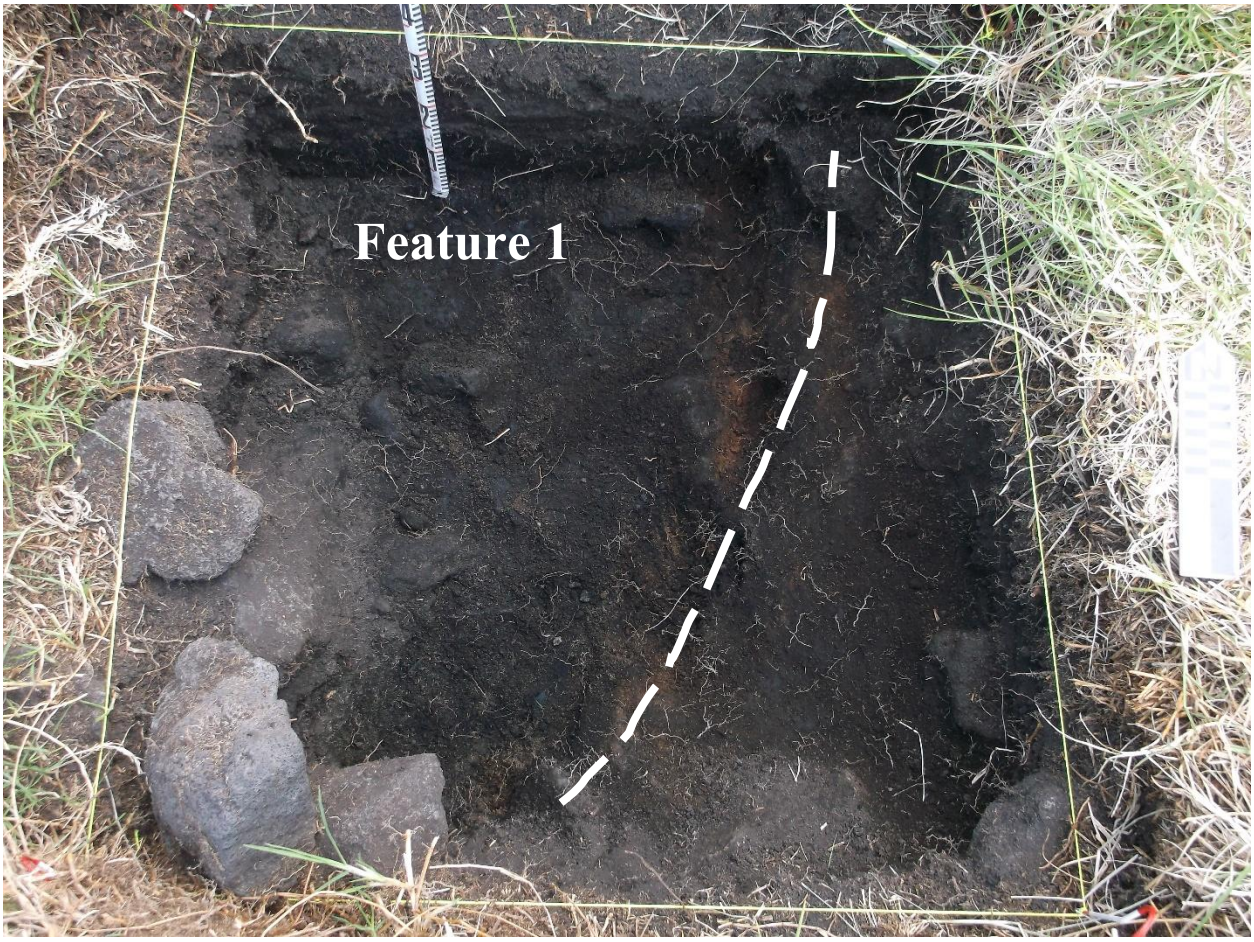
T15 (Linear Embankment): A single unit was excavated into this linear embankment (TP 12). The Bayesian model for this feature was the most complex of any associated with standing infrastructure alone. The complexity of the model owes itself to the presence of a burn layer within the feature that indicates a second period of construction following a period of stability after initial feature construction. Furthermore, the feature is a linear embankment running roughly E-W, abutting T6. As such, the construction of T-6 can be used as a TPQ for the construction of T15. Two radiocarbon determinations are available for T15. One of these was obtained beneath the basal course of stone representing the first construction period (Beta-471146), which represents a TPQ for the first phase of construction. A second was obtained from the burn layer in the middle of the construction (Beta-471148), which provides a TAQ for the first phase of construction and a TPQ for the second phase of construction. Given these constraints, the first phase of construction within T15 is the most precisely estimated construction event in the kīpuka.

SF5. North wall of T15 in TP 12. The dates from the feature were taken from beneath the basal course of stone as well as from the area indicated by the star. The size and morphology of the original wall were similar to T1 and T6.

T20 (Linear Embankment): This feature is a linear embankment that runs E-W across the kīpuka. A single unit was excavated into this feature (TP 10). The exact stratigraphic relationship between this feature and T2 is unclear, though a relationship does exist. Because of this uncertainty, no additional constraints were added. A single radiocarbon determination (Beta-471149) was used to estimate the age of feature construction, which was recovered from beneath the basal course of stone of the feature. As such, it provides a TPQ for feature construction.

SF6. North wall of T20. The date from the feature was taken from beneath the basal course of stone.

T25 (Modified Outcrop): This feature consisted of an integrated set of multiple architectural components within a modified outcrop, interpreted as a habitation structure. Three units were excavated into the modified outcrop (TP 8, TP 9, TP 14). Of the components, attention was placed on a small walled enclosure excavated in 2017 (TP 14). It is from the enclosure that a single date determination derives. While much of the feature was built atop shallow bedrock, with less than 10 cm of soil, the enclosure exhibited deeper soils. The charcoal was taken from Feature 1 located near the center of the enclosure, which appears to be an earth oven or large basin fire feature. The feature was bounded by fire-altered sediment, with subanglaur large cobbles and small boulders in and on the border of the feature. The determination provides a TAQ for the use of the feature and for the use of the modified outcrop as a whole.



SF7. Combustion feature within TP 14 excavated in the enclosure of T25. Note the orange-stained soil defining the boundary of the feature. The date was taken from within the feature.

T33 (Enclosure): This feature is an enclosure within which was found a substantial assemblage of volcanic glass flakes across eight excavation units. Eight units (TP 7, XU22, XU23, XU24, XU26, XU28, XU37, XU38) were excavated within the enclosure, and another two outside (XU46 and XU50). A paving is present within the enclosure and was identified in all excavation units. Two radiocarbon determinations were obtained from contexts related to feature construction, one from a fire feature within the feature (Beta-471150) and another from beneath the basalt stones of the enclosure retaining wall (UGAMS-66206). The latter date, from beneath the enclosure wall, represents a TPQ for feature construction. The former date, from the feature, represents a TAQ for feature construction. The feature appears to have been excavated through the paving, which abuts the enclosure wall. As such, the feature dates after the construction of the paving, which itself was built after the construction of the enclosure wall. As such, the construction of the enclosure wall is constrained on both sides by radiocarbon dates.

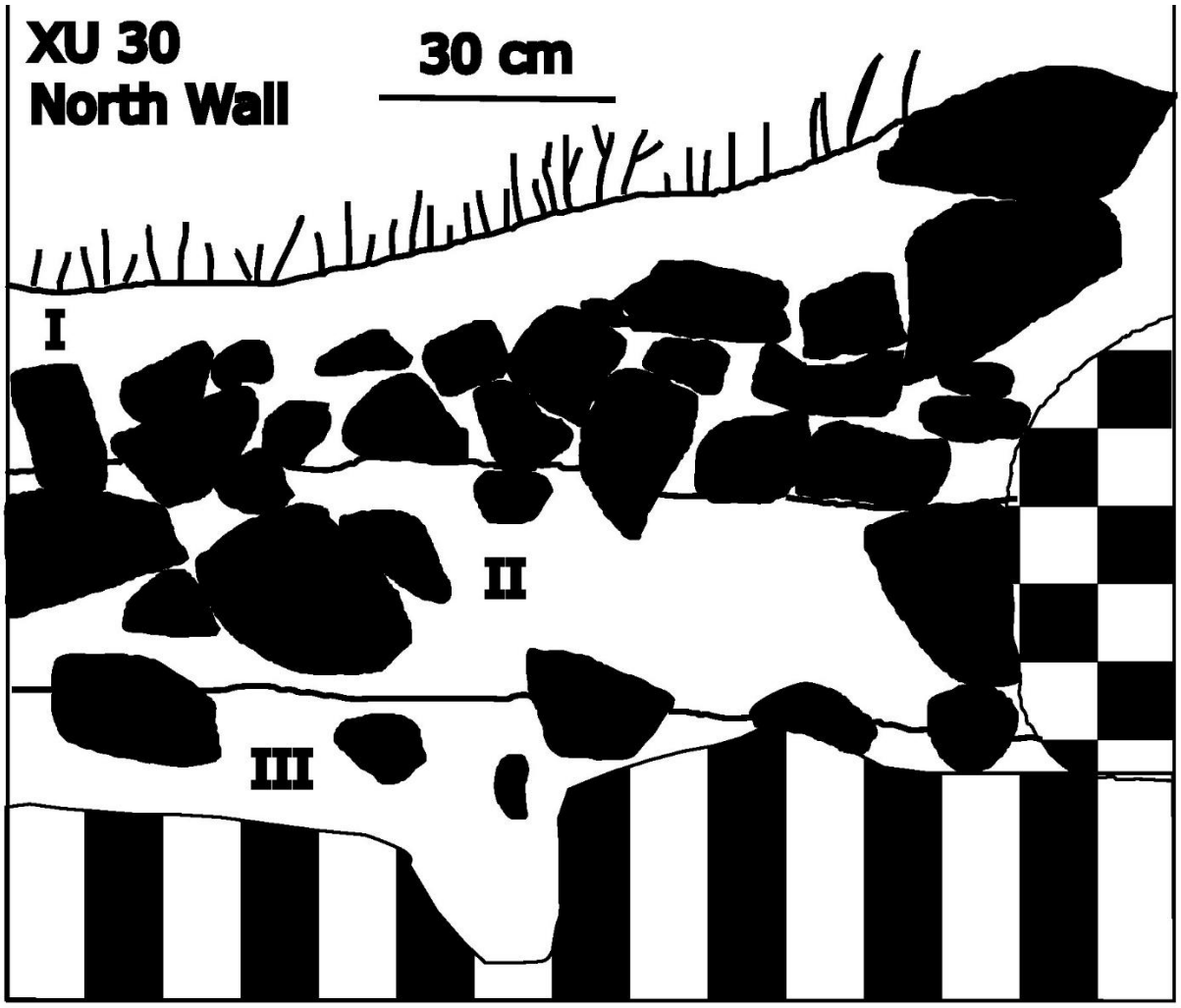
SF8. Feature found within TP7 of T33. One date was taken for the rectangular feature while another was taken from beneath the basal course of the enclosure wall. Together, these dates are used to estimate the age of feature construction.

T34 (Linear Embankment): This feature, a linear embankment running roughly E-W, is situated 5 m from the southeast edge of T33. One unit was excavated into the feature (XU47). A single radiocarbon determination is available to estimate the construction of the feature. That determination (UGAMS-77375) was recovered from beneath the basal stones of the surface feature. As such, it represents a TPQ for the construction of the feature. The charcoal that was dated is from *Broussonetia papyrifera* wood. It may have some degree of inbuilt age, but it also provides evidence for the tree in the kīpuka.

SF9. South wall of T34. The date from the feature was taken from beneath the basal course of stone.

T35 (Enclosure): Two units were excavated into the feature (XU30 and XU36). This enclosure wall was constructed adjacent, but not connected, to T33. It does, however, abut T2 on the west side of the feature, creating a D-shaped enclosure with T2. Because the T35 wall abuts T2, the construction of T-2 provides a TPQ estimate for T35. Additionally, a single radiocarbon determination (UGASM-65614) from beneath the basal stones of the T35 enclosure provides another TPQ estimate.

SF10. East wall of T35 of XU30. The date from the feature was taken from beneath the basal course of stone.

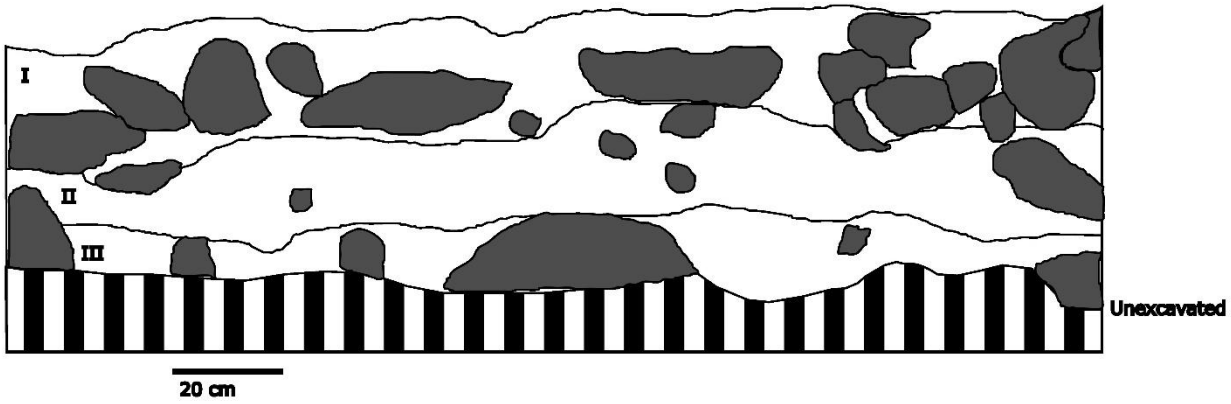


SF11. Profile of the north wall of T35. Note the position of the surface architecture in Layer I.

NPS Rock Mound: This feature is one of several hundred circular to oval rock mounds situated between linear embankments across the kīpuka. It is the only rock mound for which a radiocarbon date was obtained, excavated in 2010 by the National Park Service (TU-4). Two radiocarbon determinations are available for the feature, each excavated from beneath the basal stones of the feature. As such, they both provide TPQ for the construction of the feature. Images of the excavation are not available because the feature was excavated by the NPS.

EP1 (Enclosure): This feature is a small enclosure located on the western side of the eastern pasture. Three units have been excavated into the enclosure (XU1, XU2, XU12), with one radiocarbon determination (UGAMS-71330) available from one of these units. Charcoal for this determination was taken from beneath *in situ* paving stones of a former floor, providing a TPQ for that floor. The charcoal was *Artocarpus altilis*, and the radiocarbon date offers evidence for the presence of the tree in the eastern pasture. The location of the determination, beneath the cinder layer present across parts of the project area, is a TPQ for the deposition of that cinder.

SF12. East wall of EP1 in XU1. The date from the feature was taken from beneath the paving.



SF13. East (left side) and South (right side) wall profiles of EP1 in XU1.

EP2 (Linear Embankment): This is a small linear embankment situated within a Christmas Berry thicket at the base of the spatter cone in the eastern pasture, extending to the south. One radiocarbon determination is available for the single unit that was excavated into the feature (XU3). This determination (UGAMS-71332) was obtained from beneath the basal stones of the feature, providing a TPQ for the construction of the feature. Only indeterminate hardwood was available for dating; inbuilt age cannot be ruled out. However, this does not inhibit the use of the date as a TPQ for feature construction.

SF14. East wall of EP2 in XU3. The date from the feature was taken from beneath the basal course of stone.

EP4 (Linear Embankment): This feature is a robust but short linear embankment situated toward the eastern half of the eastern pasture. Two radiocarbon determinations are available from the single unit excavated into the feature (XU5), one on *Artocarpus altilis* (UGAMS-71335) and the other on *Euphorbia* sp. (UGAMS-71336). These two determinations provided archaeologically indistinguishable results, and both provide TPQs for the construction of the feature as they derive from below the basal stones of the feature. The former date also provides evidence for the presence of *Artocarpus* in the project area.

SF15. West wall of EP4 in XU5. The date from the feature was taken from beneath the basal course of stone.

EP5 (Linear Embankment): This feature was a more dispersed linear embankment. While the feature was identifiable in the excavation, rockfall was apparent. One radiocarbon determination (UGAMS-71333) was acquired from beneath the interpreted basalt stones of the original feature following excavation of a single unit within the feature (XU6). That determination was calculated from *Myoporum sandwicense* charcoal; as such, inbuilt age cannot be ruled out. The date still provides a TPQ for the construction of the linear embankment.

SF16. East wall of EP5 in XU6. The date from the feature was taken from beneath the basal course of stone. The basal stones were difficult to identify but are interpreted as the subrounded small boulders in this image.

EP13 (Enclosure Wall): A single radiocarbon determination (UGAMS-77373) is available for this enclosure wall, situated on a knoll overlooking a gully on the southeastern side of the eastern pasture. Two units were dug within the feature, one directly in the wall (XU13) and the other adjacent to it (XU14). The enclosure wall is part of a larger complex of features, which includes multiple tiers and at least on paving. The enclosure wall that was dated retains the complex from eroding into the gully. This determination was obtained from beneath the basal stones of the wall on the upslope side of the feature. As such, it provides a TPQ for the construction of the retaining wall, at least at this part of the wall. The charcoal dated was *Broussonetia papyrifera*, providing a TAQ for the presence of the tree in the project area. *Broussonetia papyrifera* can be longer lived. This does not affect how the date is used here.

SF17. East side of the EP13 retaining wall in XU13, looking toward the west. The date from the retaining wall was taken from under the basal course of stones.

EP16 (Terrace): This feature is a small terrace within a gully on the southeastern side of the eastern pasture. The terrace retaining wall was excavated (XU15), and a single radiocarbon determination (UGAMS-77376) was acquired beneath the basal stones. The charcoal that was dated was *Broussonetia papyrifera*. As such, the date provides a TPQ for the construction of the terrace and a TAQ for the presence of the tree in the project area. *Broussonetia papyrifera* can be longer lived, and inbuilt age for the determination is possible. This does not affect how the date is used here.

SF18. North wall of EP16 in XU15. The date from the feature was taken from beneath the basal course of stone. The basal stones were difficult to identify, at times, given the presence of naturally deposited boulders. The basal stones were defined as those that were not saprolitic and that were in Layer I.

EP17 (Terrace): This feature is another small terrace situated on the eastern side of the gully position near the southeastern boundary of the eastern pasture. Like the case of EP16, a single radiocarbon determination (UGAMS-77370) was obtained from beneath the basal stones of the excavated retaining wall (XU17). Charcoal for the determination was *Metrosideros polymorpha*, which can be long-lived. As such, the determination may be impacted by inbuilt age. However, this does not impact how the date is used here, which is as a TPQ for the construction of the terrace.

SF19. The excavated retaining wall of EP17 in XU17. This retaining was not visible on the surface. The date for the feature was taken from beneath the basal stones of this retaining wall.

EP27 (Terrace): This terrace was situated on the western slopes of the gully at the southeastern corner of the east pasture. The terrace is part of a complex of two terraces and a shallow ditch. The unit was excavated at an intersection point between these features (XU18), with charcoal obtained from beneath the basal course of stones that formed part of this feature. One radiocarbon determination (UGAMS-77374) was obtained from this charcoal, which was a piece of unidentified tuber. This determination provides a TPQ for the construction of the terrace.

SF20. The northeastern corner of EP27 in XU18. The date from this feature was taken from beneath the *in situ* basal cornerstones of the feature.

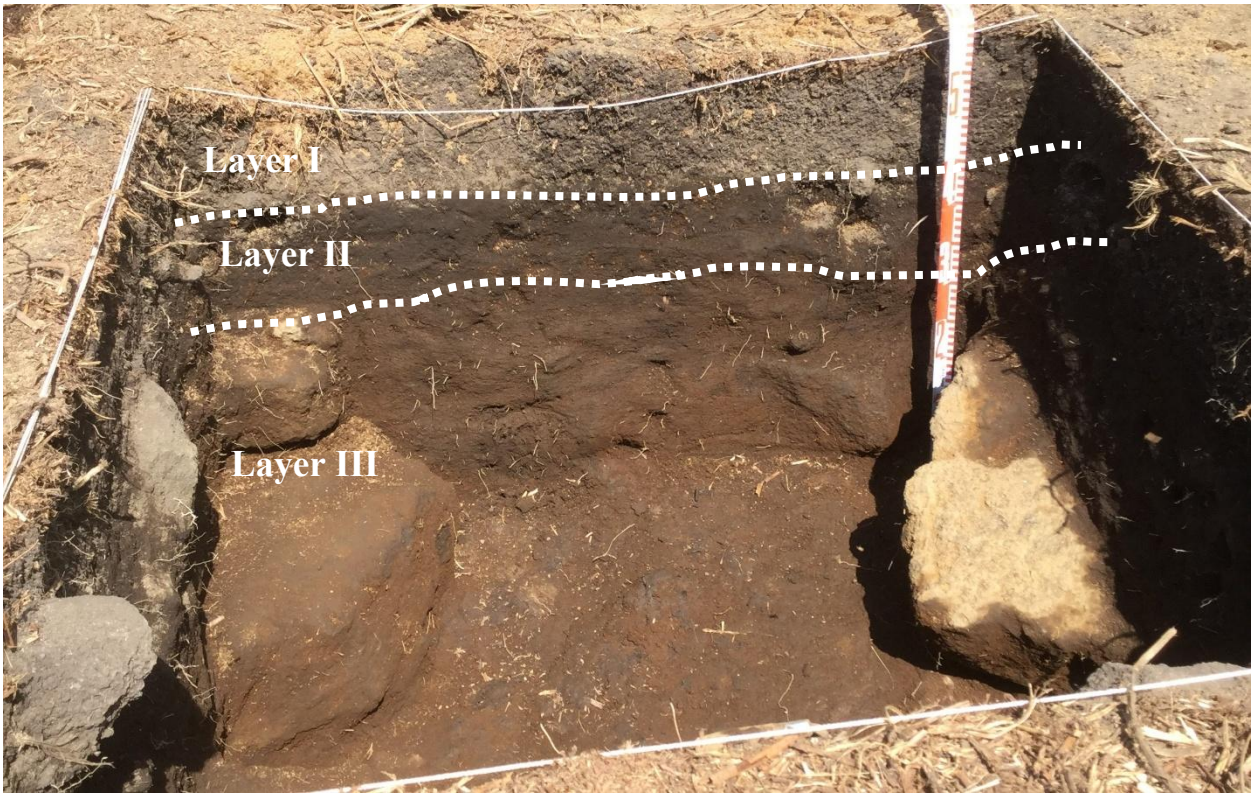
Bayesian Sequences of Subsurface Deposits

T4 (Enclosure): This feature is a large rectangular enclosure on the west side of the kīpuka within which 16 units have been excavated. The initial goal of excavation was the collection of charcoal under the surface walls of the enclosure for radiocarbon dating. However, initial excavation of the northeastern corner of the enclosure uncovered a stratified deposit with lithic and faunal assemblages. The stratigraphy and Bayesian sequences of these deposits are described below, splitting the east and west sides of the enclosure.

The stratigraphy of the east half and middle sections of the enclosure (investigated by Excavation Units [XU] 20, 27, 29, 31-32, 34-35 42-45, 48-49) was affected by the surface enclosure. However, a general profile can be described:

> Layer I was a black (10 YR 2/1, moist) silty loam with a medium to coarse crumb structure. The layer had a strong consistence, was slightly plastic, and was moderately sticky. Medium to large cobbles were found in this layer, with small boulders used as construction material for the enclosure walls, which were part of this stratigraphic unit. Few fine and medium roots were documented. Artifacts and faunal material were not found in any large quantity until the cinder transition to Layer II. Charcoal density also increased at this point. Fire-cracked rock was present amongst the charcoal. The boundary with Layer II was clear with a wavy topography.
>
> Layer II was a black (10 YR 2/1, moist) silt with a weak fine crumb structure. Root activity was substantially less than in Layer I, but few fine roots continued to be documented. The layer had a very friable consistence, was slightly plastic, and was slightly sticky. Clastics constitute less than 5% of the matrix, though the clastics that are present include both fire-cracked and waterworn rock. This fire-cracked rock is at its highest density near several fire features scattered around the enclosure. These features are roughly basin-shaped, with a few being stone-lined with flat rocks. These tend to be roughly 40-50 cm in diameter and 10-20 cm thick. Basalt and volcanic glass flakes were common in the matrix with scoria abraders, and some modified bone implements also recovered. Fauna was more common in Layer II than in Layer I. The faunal material, however, was spatially variable. The boundary with Layer III was gradual and wavy.
>
> Layer III was a dark brown (10 YR 3/3, moist) silt with a weak, very fine crumb structure. The layer had a very friable consistence. Clastics increased in this layer, and were characterized as subangular to subrounded small to large cobbles. Small, flat subrounded boulders were documented at the bottom of this layer near the interface with bedrock. At times, these boulders appeared to be placed; several features were placed between rocks. Otherwise, cobbles filled the gaps in between these flat boulders. Artifacts continued in this layer, decreasing in quantity with depth. This was the case with both charcoal and faunal material as well. Charcoal pieces were larger than in Layer II. The color of the soil became lighter with depth, reflecting a decreased amount of organic material, especially charcoal. No charcoal was recovered below the boulders, and the soil appears to be culturally sterile. In some units, a Layer IIIb or Layer IV was

designated to identify the culturally sterile component of Layer III, which was often lighter in color.



SF21. West wall of XU27 in T4.

SF22. East wall profiles of XU29 and XU30 in T4.

The stratigraphy of the far western section of the enclosure was dissimilar owing to the presence of shallow bedrock (39-41). The following describes XU-39, specifically:

> Layer I was similar to the eastern and middle sections of the enclosure, constituted by a mix of large angular to subrounded cobbles and small subangular to subrounded boulders used to construct the enclosure wall. The size of these clastics, which were 70-80% of the matrix, was largest at the top and bottom of the layer, with smaller clastics dominating in the center of the feature. The surrounding matrix was a black (10 YR 2/1, moist) silty loam with a medium crumb structure and a firm consistence. The layer was slightly plastic and slightly sticky. Many fine roots and few medium roots were documented. Charcoal was relatively rare in the unit, but increased with depth. Artifacts and faunal material were found in the layer but in low quantities until the interface with Layer II. Soil in the eastern half of the unit was thin, lying atop a degrading lava flow surface. In at least some areas, Layer I lies directly on top of these boulders; this is especially the case for XU-40. The transition to Layer II was clear with a wavy topography.
>
> Layer II was a very dark brown (10 YR 2/2, moist) silt to silty loam sediment with a fine crumb structure and a weak very friable consistence. Clastics constituted less than 5% of the matrix and consisted of subrounded medium to large cobbles. Root activity was rare, with few fine roots. Artifacts and faunal material were more common in this layer, and they included bird bone, several volcanic glass cores, flakes, and other materials. Waterworn basalt and some highly degraded coral were found in the layer, similar to Layer II in the eastern and middle parts of the enclosure. Some ash was also found in addition to a higher density of charcoal, especially directly below the basal stones of the enclosure. This layer clearly runs below the wall and was deposited before the construction of the feature, consistent with the chronology of Layer II in the eastern and middle sections of the feature. Subrounded flat boulders that were well fit together were exposed at the bottom of this layer, suggestive of a cracked lava flow. Layer III was identified between these stones. The boundary with Layer III was clear with a straight topography.
>
> Layer III was a thin dark brown (10 YR 3/3, moist) silt with a very fine crumb structure and a weak very friable consistence. The layer was not sticky or plastic. Root activity was limited and clastics constituted 80-90% of the matrix. This same layer was found beneath the lava flow stones and was culturally sterile. The lack of material in this layer is distinct from Layer III in the eastern and middle sections of the enclosure.

Layers I and II are largely similar across the enclosure, separated by a thin layer of cinder. Additional cultural material is evident in Layer III in the eastern and middle sections of the enclosure, but are absent from the western sections excavated. Instead, the western section of Layer III is sterile — the limited cultural material that includes small pieces of charcoal is interpreted to stem from Layer II. Given these slight differences, two models were created.

The eastern and middle model begins with the deposition of Layer III. This phase includes three date determinations from Layer III: UGAMS-66207, -66208, and -65613. One date was removed

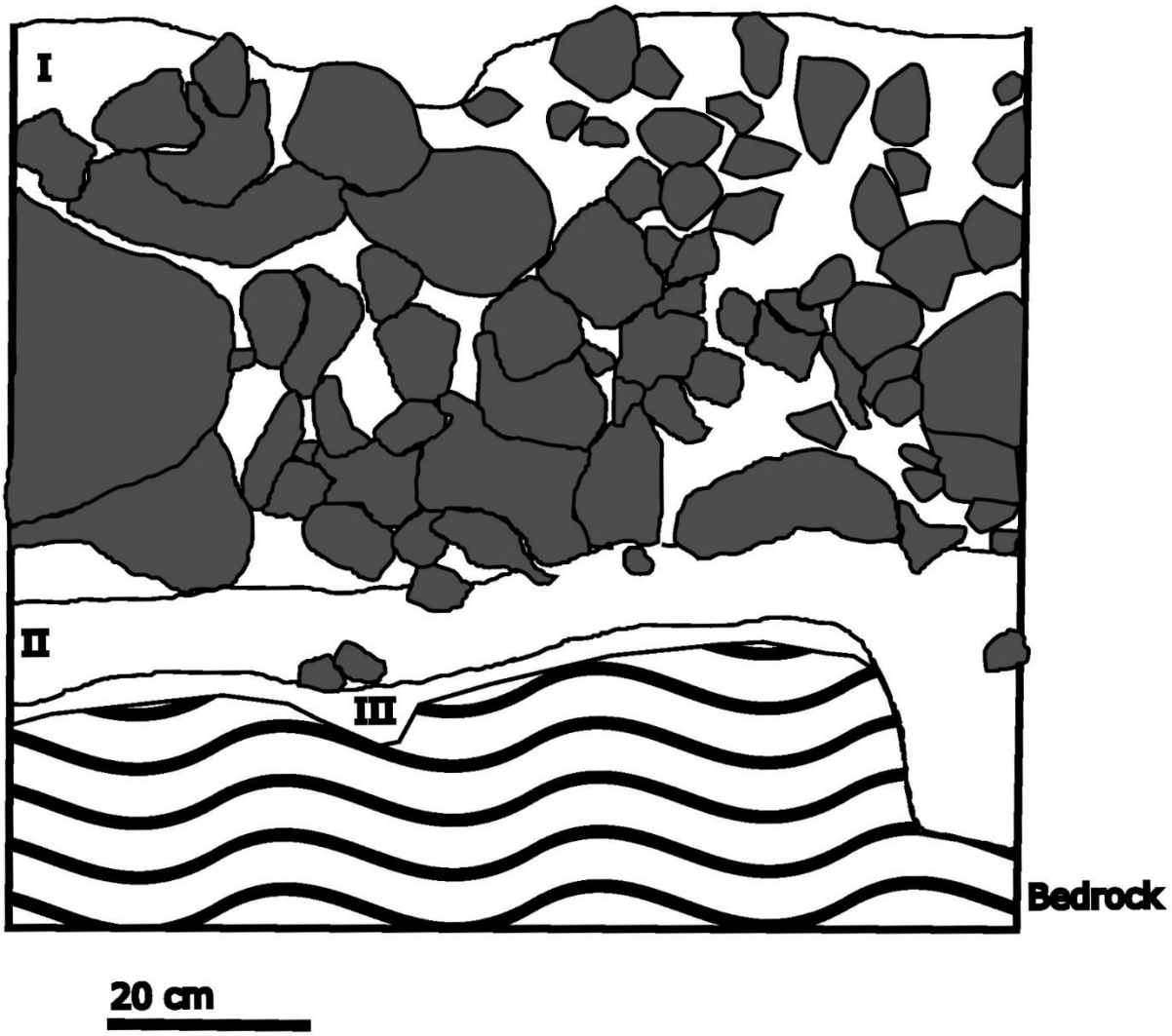
from the model, UGAMS-65616, because of very low agreement. The charcoal for this date was taken from the screen rather than from an *in situ* location. It is interpreted to have been displaced during excavation. UGAMS-66207 was also identified for a low individual agreement (39.5%) and as an outlier when an outlier model was applied. However, this does not cause the overall model to fall below the 60% agreement index threshold, and the posterior distribution of the date overlaps strongly with the prior distribution. As such, it was included in the model. This may suggest some level of bioturbation between Layer II and III. The deposition of Layer III is followed by the boundary between Layer II and III. Layer II is represented by two date determinations. These two dates are structured in that UGAMS-66205 was taken from a feature at the interface between Layer II and III, which is stratigraphically lower than the position of UGAMS-77372 at the top of the layer near the interface with Layer I. This was the position of cinder deposition and the boundary for Layer I and II. The deposition of Layer I included two radiocarbon determinations along with the construction of two enclosure walls. All of these events served as TAQs for previous depositional events. UGAMS-71329 was taken from beneath the basal stones of the northern cross slope wall that abutted the eastern N-S trending wall. This determination serves as a TPQ for that wall. The second determination from Layer I was taken from beneath the basal stones of the N-S trending wall that is abutted by the cross-slope wall. This date serves as a TPQ for the N-S wall. All three of these events are TPQs for the cross-slope wall, given that the N-S wall was constructed prior to the cross-slope wall on stratigraphic grounds. The model can be visualized as follows:

Boundary T4 Start > Phase (Layer III Dates) > Boundary (Layer III/II Boundary) > UGAMS-66205 > UGAMS-77372 > Event of Cinder Deposition > Boundary (Layer II/I Transition) > Phase (Cross Slope Wall TPQs[UGAMS-71329] and [Sequence UGAMS-65612 > East Wall Construction]) > Boundary (Cross Slope Wall Construction)

The model for the western section of the enclosure is simpler and includes two date determinations, both taken from XU-39. UGAMS-71331 was taken from the space between cracked lava flow and is interpreted to reflect intrusive material from the base of Layer II. This determination provides a TPQ for Layer I deposition and the deposition of cinder. The determination was identified as having a low agreement index (45.4%) and was identified as an outlier when an outlier model was applied. However, it was retained because the posterior distribution overlapped strongly with one part of the prior distribution. UGAMS-71334 was taken from directly below the N-S trending wall on the west side of the enclosure, providing a TPQ for that wall but also a TAQ for the deposition of cinder. The construction of this N-S wall is further constrained by a TAQ, which was the estimated construction age of the northern cross-slope wall of the enclosure that also abuts the western N-S trending wall, as it does the eastern wall.

The model is visualized as follows:

Boundary West Wall Start > UGAMS-71331 > Boundary (Layer I/II Transition) > UGAMS-71334 > Boundary (West Wall Construction) > Estimated date of cross slope wall construction



SF23. West wall profile of XU39 in T4. Note that the surface architecture is in Layer I and the thin nature of Layer III lying atop bedrock, which is dissimilar to the thicker Layer III in the eastern half of the feature.

EP6 (Enclosed Terrace): This feature is an enclosed terrace situated on the western side of the southeastern gully in the east pasture. The enclosure is badly damaged, presumably from 19th and 20th century ranching activity. A fence line runs across the feature, with at least some rock from the feature used to stabilize parts of the fence. Furthermore, it appears that boulders have been piled on the retaining wall that constitutes the eastern boundary of the feature. Excavation was carried out to better understand the function of the feature, given this disturbance. Four units were excavated (XU7, XU8, XU9, XU10, XU11), and the highest rates of cultural material were found near the retaining wall (XU10 and XU11). The stratigraphy and Bayesian sequences of these deposits are described below.

Layer I was a dark brown (10 YR 2/2, moist) silty loam with a fine to medium crumb structure and a firm consistence. The matrix was slightly sticky and slightly plastic. Few large roots and many fine roots were noted. Clastics were not frequent, constituting less than five percent of the matrix. Those present included flat large cobbles and small boulders. These seem to form a paving, though this paving is not as dense as identified in other habitation features. Cultural material was rare in this layer, other than charcoal, which increased with depth. Cinder was noted at the transition to Layer II, though this was more noticeable in some units than others. The boundary with Layer II was clear with a wavy topography.

Layer II was a dark brown (10 YR 2/2, moist) silty loam with a fine to very fine crumb structure and a very friable consistence. The matrix was non-sticky and non-plastic. Root activity was considerably less visible with few large and medium roots. Clastics continued to be relatively rare, though the density of these clastics was higher closer to the retaining wall. These clastics included subrounded to subangular large cobbles. Small flat boulders were also identified upright and forming a feature in one excavation unit. This feature included a heavy concentration of charcoal, which extended to bedrock. Charcoal was also relatively common outside the feature, likely stemming from the rake out of the feature. Artifacts were more common, including volcanic glass and basalt flakes. An abrader was also found at the interface with Layer I. The transition to Layer III was gradual with a broken topography.

Layer III was a dark yellowish brown (10 YR 3/4 or 3/6) silty loam with a fine to very fine crumb structure and a very friable consistence. The matrix was slightly sticky and slightly plastic. Root activity was similar to Layer II, with few moderate and large roots. Clastics continued to be relatively rare, constituting less than five percent of the matrix. These clastics were subrounded to subangular medium to large cobbles. Charcoal was still present at a lower density than Layer II. Charcoal was more visible on the eastern side of the feature than on the western side. Artifacts also persisted, though again at a lower frequency. Possible oven stones were identified near the retaining wall, roughly a meter from the feature in the prior layer. The boundary with Layer IV was gradual with a broken topography.

Layer IV was a dark yellowish brown (10 YR 4/6, moist) silt with a very fine crumb structure and a very friable consistence. The matrix was non-sticky and non-plastic. Root

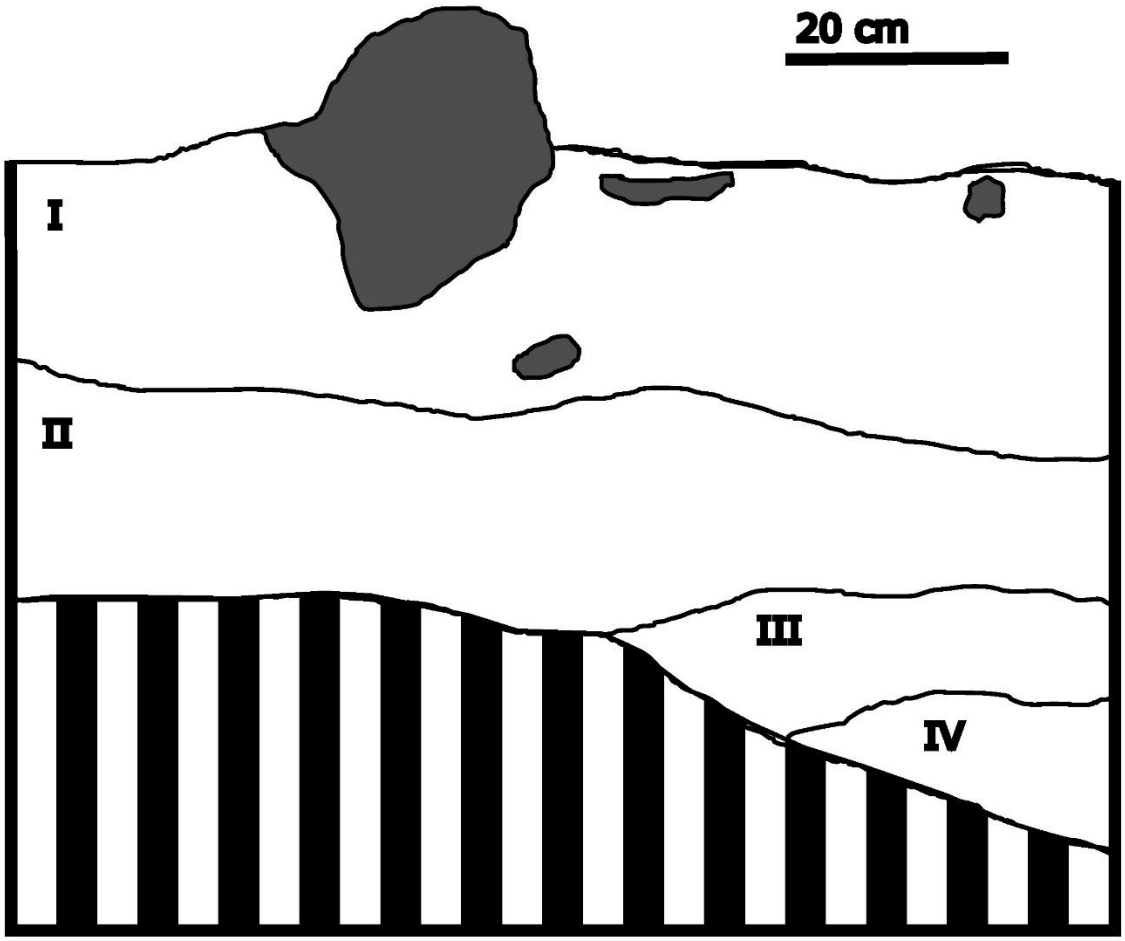
activity was noted in some units near bedrock, but this was minimal. Cobbles were also present at a lower frequency. These were small to large, ranging from rounded to subrounded, with some being saprolitic. Cultural material was rare, with some charcoal scattered around the layer at a far lower frequency than in Layer III. This layer is more visible on the eastern side of the enclosure, being thin or absent as one moves to the west. The layer lies directly atop bedrock.

Three dates are available from EP6: one from XU7 and two from XU-11. These two units are located near the eastern retaining wall of the feature, with the latter unit including the large stone-lined hearth. Two radiocarbon determinations (UGAMS-77368, -77369) derive from the stone-lined hearth in Layer II, while the third (UGAMS-77371) originated from beneath an interpreted paving stone just above the thin layer of cinder. Given the stratigraphic positions of these dates, feature construction cannot be estimated. Rather, what is estimated is the use of the hearth along with the transition between Layers I and II, which corresponds to the deposition of cinder.

Both determinations from the stone-lined hearth are presumably associated with burning in the hearth. As such, these determinations provide TAQs for the construction of the hearth. These dates also constrain, on the lower boundary, the age of the transition from Layer I to Layer II. The third determination constrains this same transition on the upper boundary, being a TPQ for the deposition of cinder in the project area. The model can be visualized as follows:

Boundary EP6 Start > Boundary (Stone-lined Construction) > Phase (Hearth TAQs) > Boundary (Layer I/II Transition) > UGAMS-77371

SF24. XU11 in EP6. The image on the left is a portion of the paving that lies atop of a thin layer of cinder across the project area. The image on the right is the stone-lined combustion feature from which two dates derive.



SF25. North wall profile of XU11. The combustion feature was associated with Layer II.

Construction of Bayesian Model for Deposition of Cinders

Excavation of features uncovered a marked transition between the surface layer and subsequent Layer II. This transition included a thin layer of black and brown cinder, most of which was less than 3 cm in diameter. These cinders were most noticeable in habitation structures, and paving stones were placed atop these cinders in T33, EP1, and EP6. However, the cinders are thickest and stratigraphically best defined in T4. The deposition of cinders across such a larger area is suggestive of a regionally-significant volcanic event. The age of this event is modelled by estimating the deposition of this cinder layer using radiocarbon determinations from beneath (TPQs) and above (TAQs) the layer. The model structure is as follows:

Boundary (Begin Depositions) > Phase (Cinder TPQ) > Boundary (Cinder Deposition) > Phase (Cinder TAQ)

The placement of paving stones on cinder also illustrates the persistent use of houses through the period of agricultural fields.

Construction of Occurrence Plots

The MCMC output generated in OxCal by running the Bayesian model was exported as a .csv and used as the input to construct plots in ArchaeoPhases (Phillipe et al. 2017). We used only events of feature construction to develop graphics in ArchaeoPhases. The primary graphic used was the occurrence plot, which is described and interpreted in the main text as well as below.

Occurrence plots estimate the number of events (n; y-axis) that have occurred by a given time (t; x-axis). In this case, the events of interest were examples of feature construction within a specified area. The plot considers all construction events jointly, as the graph does not specify which specific element of infrastructure was constructed first. Rather, it specifies that within a time range, 1, 2, 3, …, etc. elements of infrastructure were constructed. Occurrence plots provide a systematic mechanism to compare the joint rate of construction between different areas.

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Table S1. Comparison of dated construction events (95.4% HPD) using a Bayesian structure with and without an outlier model applied to charcoal dates.

Event of Feature Construction	No Outlier		Outlier	
	Early	Late	Early	Late
T1	1456	1741	1456	1743
T2	1479	1647	1477	1649
T3	1650	1825	1640	1843
T4 East	1647	1821	1670	1821
T4 Cross	1680	1821	1677	1840
T4 West	1552	1823	1557	1825
T6	1474	1624	1474	1626
T9	1459	1735	1459	1738
T15 Early	1488	1630	1488	1632
T15 Late	1486	1705	1487	1704
T20	1661	1826	1657	1832
T25	1485	1755	1483	1757
T33	1520	1813	1519	1814
T35	1487	1730	1486	1729
EP1	1475	1746	1473	1750
EP2	1521	1758	1520	1768
EP4	1513	1714	1512	1718
EP5	1534	1826	1532	1824
NPS Rock Mound	1532	1821	1530	1810
EP13	1688	1846	1687	1846
EP16	1521	1758	1520	1770
EP17	1673	1825	1672	1827
EP27	1522	1764	1520	1770
T34	1498	1752	1497	1758