Supporting Information

Stiner et al. 10.1073/pnas.1322723111

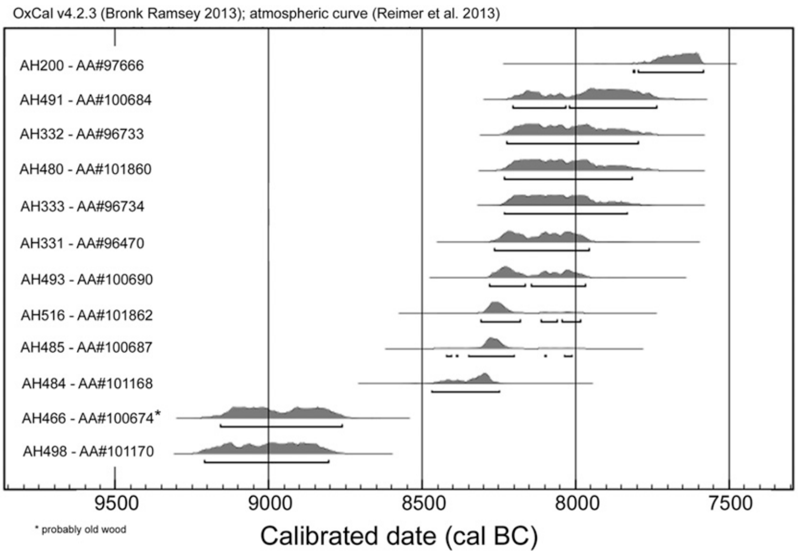

Fig. S1. Plot of radiocarbon results (cal B.C.) from combustion and other short-lived features in upper Level 4 of Aşıklı Höyük (AH) [OxCal v4.2.3 (1, 2)]. Note that most determinations are for the uppermost part of Level 4 in Trench 4GH on the north side of the mound, whereas the oldest determination (AA# 101170, from provisionally named Level 5) is for a sample obtained near the base of the mound in Trench 2J on the western slope. Brackets below each distribution (|____|) signify 95% confidence interval.

1. Bronk Ramsey C (2009) Bayesian analysis of radiocarbon dates. *Radiocarbon* 51(1):337–360.
2. Reimer PJ, et al. (2013) IntCal13 and Marine13 radiocarbon age calibration curves 0-50,000 years cal BP. *Radiocarbon* 55(4):1869–1887.

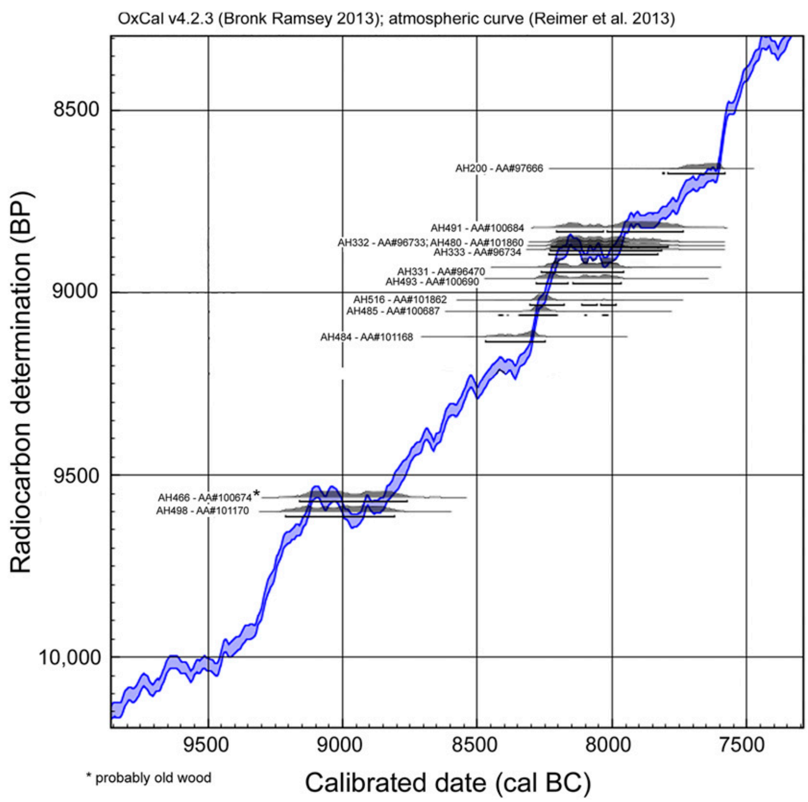

Fig. S2. Radiocarbon results from combustion and other short-lived features within Level 4 of AH plotted on OxCal v4.2.3 calibration curve (1, 2). Note that most of the currently available determinations are for uppermost Level 4 in Trench 4GH, whereas the oldest determination (AA# 101170) is for a sample obtained near the base of the mound on the western slope (Trench 2J).

1. Bronk Ramsey C (2009) Bayesian analysis of radiocarbon dates. *Radiocarbon* 51(1):337–360.
2. Reimer PJ, et al. (2013) IntCal13 and Marine13 radiocarbon age calibration curves 0-50,000 years cal BP. *Radiocarbon* 55(4):1869–1887.

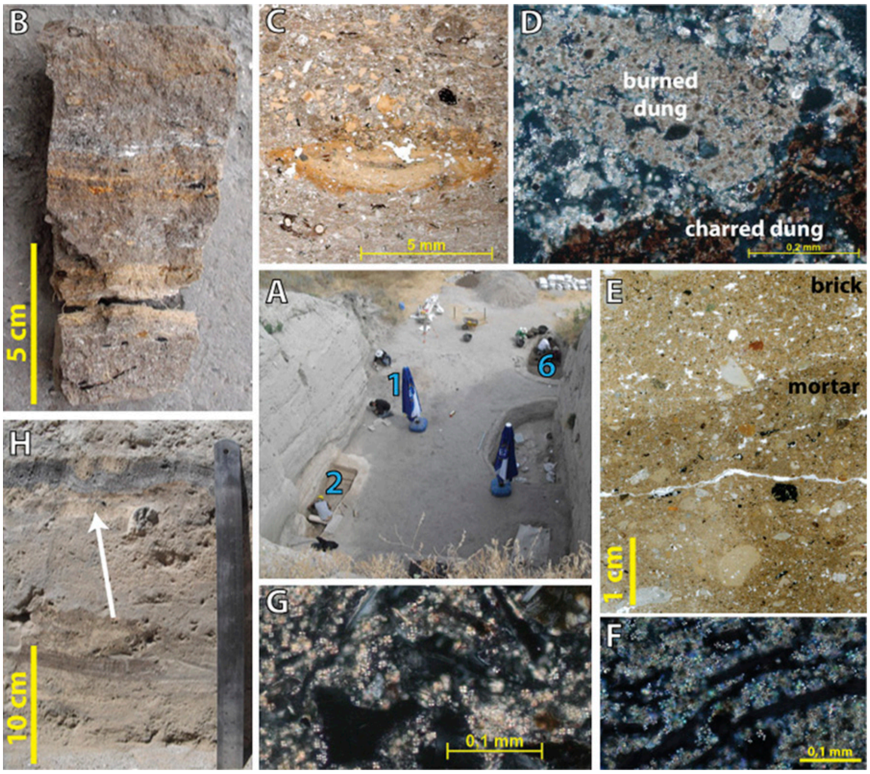

Fig. S3. Geoarchaeological evidence of primary dung deposits and secondary uses of dung in upper Level 4. (*A*) View of the Deep Trench (4GH) on the northern end of the mound, with excavators uncovering several open spaces and structures within upper Level 4. The locations of different types of dung deposits are indicated by architectural feature numbers. Space 1 contains intact layers of dung, and is underlain by spaces 7 and 13, which also contain sporadic but intact dung. Building 6 contains burned dung within its hearth and occupation deposits. Dung is also present in the mortar of the building's walls. Building 2 contains an intact layer of dung located above a floor. (*B*) Detail of dung layers in a micromorphology block collected from just above space 1. The dung appears orange and fibrous in the field, with numerous visible phytoliths. Field analyses of these types of layers include observations of color, reaction to acid, and smear slide production. Smear slides of dung deposits such as this one contain abundant phytoliths and spherulites. (*C*) Photomicrograph of the sample in *B*. Concentrations of yellow-orange secondary phosphate minerals are visible. These minerals form as a result of decomposition of the dung and contribute to the orange color that is visible in the field. Plane-polarized light. (*D*) Photomicrograph of burned and charred dung from the hearth in Building 6. When dung is burned under reducing conditions, the optical properties of the spherulites become altered. The dung was used as fuel within the structure, as evidenced by its presence within the hearth, as well as within generalized occupation debris. Cross-polarized light. (*E*) Incident light scan of a sample of brick and mortar from Building 6. The mortar was produced from anthropogenic refuse and contains aggregates of construction materials, ashes, fragments of charcoal, hackberry seeds, and dung (burned and not burned). (*F*) Intact dung from the upper Level 4 midden (location not visible in *A*). Intact dung is evidenced by interbedded phytoliths (here, black areas) and spherulites (light areas) with an overall undulating and laminated fabric (1). Relative to the dung in *C*, this dung is less affected by postdepositional decomposition, as evidenced by lower abundance of secondary phosphates and preservation of calcium oxalate crystals. Cross-polarized light. (*G*) Photomicrograph of a dense dung layer within Building 2. The light areas are concentrations of dung spherulites. The presence of only localized undulating laminated fabric indicates that this deposit may be in secondary position, or reworked in place. Cross-polarized light. (*H*) The dung layer from *G* located above a series of plaster floors in Building 2. The dung (arrow) is overlain by a deposit containing charred plant fibers and phytoliths.

1. Shahack-Gross R, Finkelstein I (2008) Subsistence practices in an arid environment: A geoarchaeological investigation in an Iron Age site, the Negev Highlands, Israel. *J Archaeol Sci* 35(4):965–982.

Table S1. Recently obtained radiocarbon results on burnt plant materials from discrete short-lived (mainly combustion) features in AH in Trenches 4GH (deep sounding in the northern area of the mound) and 2J on the western slope

UA Laboratory AA no.	AH project sample no.	Trench	Unit	Feature	Space	Building	Context description	Level	Elevation	Material	Context type	^{14}C yrs	±	cal B.P.	cal B.C.	±	2 σ	Range
AA101180	509	2J	570	371	138	17	Hearth	2/3	8.49	Charcoal	Hearth	8860	50	9970	8020	210	10,172	9,760
AA101182	511	2J	550	331	—	—	Fire installation	3	8.84	Charcoal	Combustion feature	8830	50	9930	7980	230	10,156	9,698
AA101183	512	2J	550	331	—	—	Fire installation	3	8.84	Charcoal	Combustion feature	8790	50	9870	7920	270	10,135	9,601
AA100674	466	2J	551	332	128	18	Reed floor	3	9.01	Burned roof timber*	Burned layer	9560	60	10920	8970	220	11,136	10,701
AA101178	507	2J	587	372	134	18	Hearth	3	9.91	Hearth charcoal	Hearth	8710	50	9690	7740	140	9,824	9,546
AA101177	506	2J	598	—	—	—	Hearth	3	10.14	Hearth charcoal	Hearth	9010	50	10090	8140	160	10,249	9,929
AA101172	501	2J	584	—	—	—	West profile, major burn layer	3	10.31	Charcoal	Burned layer	8900	50	10050	8040	160	10,196	9,886
AA101173	502	2J	584	—	—	—	West profile, major burn layer	3	10.31	Burnt dung	Burned layer	8870	50	9980	8030	210	10,179	9,766
AA101176	505	2J	598	—	—	—	Hearth	3	10.31	Hearth charcoal	Bearth	8900	50	10050	8100	160	10,196	9,886
AA101181	510	2J	585	366	136	20	Hearth	3	10.8	Hearth charcoal	Hearth	8720	50	9690	7740	140	9,834	9,550
AA101170	498	2J	584	—	—	—	West profile, major burn layer	base†	11.67	Charcoal	Burned layer	9600	50	10960	9010	200	11,160	10,756
AA100684	491	4GH	249	—	—	—	South wall, burnt dung	3/4	8.52	Burnt dung	Burned layer	8820	50	9930	7980	240	10,156	9,686
AA100690	493	4GH	255	84	15	1	Burial 131	4	10.73	Charcoal	Burial	8960	50	10080	8130	160	10,228	9,916
AA97666	200	4GH	105	32	5	3	Fire installation	4	11.19	Seed	Combustion feature	8660	50	9640	7690	110	9,532	9,744
AA96733	332	4GH	154	51	2	—	Fire installation	4	11.35	Charcoal residue	Combustion feature	8860	50	9970	8020	210	9,760	10,172
AA100687	485	4GH	227	73	2	—	Fire installation	4	11.46	Hearth charcoal	Combustion feature	9050	50	10220	8270	70	10,297	10,151
AA101862	516	4GH	227	73	2	—	Fire installation	4	11.46	Charcoal	Combustion feature	9020	50	10090	8140	160	10,254	9,933
AA101168	484	4GH	251	—	—	—	N of space 13, burnt phyto area	4	11.69	Charcoal	Burned layer	9120	50	10310	8360	110	10,416	10,197
AA101860	480	4GH	157	53	6	6	Base of Building 6	4	12.39	Burnt layer	Build-fill-base	8870	50	10370	8420	130	10,493	10,238
AA96734	333	4GH	149	49	6	6	Hearth	4	12.51	Charcoal	Hearth	8880	50	10020	8070	160	10,182	9,856
AA96470	331	4GH	149	49	6	6	Hearth	4	12.52	Charcoal residue	Hearth	8930	50	10070	8120	160	10,216	9,905

Results include samples from the lower part of Level 2, selected locations in Level 3 and uppermost Level 4 (key information color-highlighted), and one collected near the base of the mound on the western slope (Trench 2J).

*Early date in this instance probably reflects old wood problem.

†Sample taken from feature near base of cultural stratigraphy on the western side of the mound; this deposit is provisionally named Level 5.

Table S2. Relative abundance (number of identified skeletal specimens, NISP) of major taxonomic groups by level and level subsection in AH

Taxon	2A	2B	2C	2D	2E	2F	2G	2H	2I	2J	3A	3B	3C	3E	4a-4c	4d	4e
Toads/frogs (Anura)	—	6	12	3	—	—	—	1	1	5	8	6	—	8	89	78	96
Mice/voles (Rodentia)	—	37	—	9	—	—	—	1	15	40	90	5	—	—	178	38	24
Carp (Pisces)	—	5	2	36	4	—	—	—	62	513	346	30	216	44	886	429	377
Hedgehog (*Erinaceus*)	—	—	—	—	—	—	—	—	—	—	—	—	3	—	56	56	51
Tortoises/turtles (Chelonians)	—	4	2	7	4	5	1	3	—	14	2	1	10	1	163	105	165
Hare (*Lepus capensis*)	3	34	259	146	147	115	49	54	6	558	50	7	339	62	1,717	899	1507
Birds (Aves)	1	5	17	10	16	13	2	11	—	9	4	—	2	—	66	46	64
Horse/wild ass (Equidae)	3	31	67	45	16	86	44	28	10	370	12	16	38	10	139	114	180
Deer (3 species, Cervidae)	7	24	66	32	20	70	39	11	2	539	6	3	28	15	67	40	96
Aurochs (*Bos primigenius*)	139	219	689	364	175	411	217	123	27	1,961	123	23	30	13	306	212	823
Pig (*Sus scrofa*)	13	18	40	78	53	177	128	46	6	372	20	7	70	14	168	138	260
Goat (*Capra aegagrus*)	172	171	295	209	111	320	193	52	5	253	19	3	17	4	128	133	55
Sheep/goat (Caprini)	1,286	1,990	4,743	4,470	1,311	4,397	1,770	412	104	11,104	431	132	898	168	2,909	1,706	1,576
Sheep (*Ovis orientalis*)	381	501	1,328	1,118	434	1,450	937	260	29	1,460	135	30	45	51	414	254	176
Carnivores (Carnivores)	—	8	14	35	20	42	12	7	1	68	5	—	36	3	224	181	197
Total NISP	2,005	3,053	7,534	6,562	2,311	7,086	3,392	1,009	268	17,266	1,251	263	1,732	393	7,510	4,429	5,647

Note that Level 4a-d corresponds to the upper part of the Level 4, and 4e represents the upper-middle part of Level 4. Data are for faunal samples excavated through the 2013 field season.

Table S3. Summary of fusion states of tibias and metapodials by ungulate taxon

Taxon	% Juveniles	% Adults	Element-end (MNE)
Equidae	40	60	Distal tibia (10)
Bos	53	47	Distal tibia (19)
Caprines*	69	31	Distal metapodials (71)
Sus	26	74	Distal metapodials (22)

Percentages of juvenile (including infants) versus adults by ungulate taxonomic group in upper Level 4, based on limb bone fusion at or near the time of the deciduous-permanent premolar replacement boundary. MNE, minimum number of elements.

*Caprine limb fusion estimate excludes fetal bones.

Table S4. Raw and percentage data for caprine bone fusion by element and element-portion from the uppermost and mid-upper parts of Level 4, with very young (fetus and neonate combined) specimens listed separately

Element-portion	MNE fused	MNE unfused	MNE fetus-neon	total MNE	% MNE fused	%MNE unfused	%MNE fetus-neon	Sample source from within Level 4
Phalanx 1 – proximal	55	34	4	93	59	37	4	Uppermost
Innominate – acetilium	28	14	7	49	57	29	14	Uppermost
Tibia – distal	39	23	3	65	60	35	5	Uppermost
Metapodial – distal	15	27	11	53	28	51	21	Uppermost
Calcaneum – tuber calc.	21	33	1	55	38	60	2	Uppermost
Femur – proximal	9	26	8	43	21	60	19	Uppermost
Tibia – proximal	12	24	3	39	31	61	8	Uppermost
Radius – distal	13	24	6	43	30	56	14	Uppermost
Phalanx 1 – proximal	28	12	1	41	68	29	3	Mid-upper
Innominate – acetilium	13	5	3	21	62	24	14	Mid-upper
Tibia – distal	14	13	1	28	50	46	4	Mid-upper
Metapodial – distal	7	14	2	23	30	61	9	Mid-upper
Calcaneum – tuber calc.	4	17	0	21	19	81	0	Mid-upper
Femur – proximal	4	6	1	11	36	55	9	Mid-upper
Tibia – proximal	6	11	1	18	33	61	6	Mid-upper
Radius – distal	7	16	3	26	27	62	11	Mid-upper

Percentages of juveniles (including infants) versus adults by ungulate taxonomic group in upper Level 4, based on limb bone fusion at or near the time of the deciduous-permanent premolar replacement boundary.

Table S5. Analysis of the distributions of fetal versus neonate specimens by ungulate taxon in upper Level 4

Taxon	NISP fetus	NISP neonate	NISP (undetermined) fetus or neonate	*N*	*P**	$P^{\dagger}$
Equidae	0	10	2	12	0.144	0.021
Bos	0	18	3	21	0.034	0.001
Caprines	30	64	107			
Sus	0	22	4	26	0.015	<0.001
Cervidae	0	0	0			

N, hypothetical sample of size; $P^* = (1 - 0.149)^N$ or $(0.851)^N$; $P^{\dagger} = (1 - 0.319)^N$ or $(0.681)^N$. Neonate specimens were distinguished whenever possible from fetal specimens based on known age reference skeletons. Among the caprines from the upper part of Level 4, there are 201 bones attributable to either fetal or neonate individuals. Of these, definitively fetal bones constitute 14.93% (n = 30). Of the remainder, 64 (31.8%) are clearly neonates, and for another 107 very young specimens (53.2%) it is impossible to determine whether they are neonate or fetal. There are no unambiguous fetal bones found in the assemblage for any of the other taxa. Because we cannot use a χ^2 to evaluate differences among them as a result of the large number of empty cells in the data, we instead turn to simple probabilities. The question is whether the absence of fetal bones for Equids, *Bos*, and *Sus* demonstrate that they are sampling a different population of age groups than the caprines (the baseline for this comparison), or whether this could simply be an effect of smaller sample sizes. Assuming an actual frequency of fetal bones at 14.9% of the combined fetal+neonate sample, we can calculate the probability of selecting a hypothetical sample of size *N* in which there are no fetal bones. This is the same as 1 – (probablility of selecting only neonate or indeterminate bones). Note that there are neither fetal nor neonate bones for cervids, so no calculation is possible for this taxonomic group. The results presented above show that it is very unlikely that the absence of fetal bones in the samples of *Bos* and *Sus* is a result of sampling error alone. Because of the smaller number of Equid bones available for study, we cannot be certain that the absence of fetal specimens is not a sampling effect, although there is only a 14.4% chance that this is the explanation.
*Results for all three categories: fetus, neonate, and underdetermined fetus-neonate.
†Results for only two categories: fetus, neonate (excludes underdetermined fetus-neonate specimens.

Table S6. Dental-based age profile calculations and results for AH upper Level 4 caprines following Payne's (1) mandibular age stages (MNE = 82), and adjusted using the technique described by Helmer et al. (2) to include isolated tooth specimens

AH Level 4 Caprine dental age structure following Payne (1)	A (0–2 mo)	B (2–6 mo)	C (6–12 mo)	D (1–2 y)	E and F (2–4 y)	G (4–6 y)	H and I (6–10 y)
Raw counts (MNE)	2	3	13	16	0	0	0
Proportionally assigned	0	1.2	6.2	3.7	20.76	6.37	9.78
Corrected (raw+prop assign)	2	4.2	19.2	19.7	20.76	6.37	9.78
% total MNE	2	6	23	24	25	8	12

1. Payne S (1973) Kill-off patterns in sheep and goats: The mandibles from Asvan Kale. *Anatolian Studies* 23:281–303.
2. Helmer D, Gourichon L, Vila E (2007) The development of the exploitation of products from *Capra* and *Ovis* (meat, milk, and fleece) from the PPNB to the Early Bronze Age in the northern Near East (8700-9200 cal BP). *Anthropozoologica* 42(2):41–69.

Table S7. Data and Kolmogorov–Smirnov test results for comparisons of caprine survivorship based on dental results for upper Level 4 (all units combined) to Epipaleolithic (EPI) and other PPN cases from other sites

Site and component	Period	Source	*n* specimens	A	B	C	D	EF	G	HI	*D* value	df	0.05 Rejection threshold	*P*
Aşıklı Level 4	Early PPN	–	82	2	4	19	20	21	6	10	–	–	–	–
Göbeklı Tepe*	PPNA	Peters et al. (1)	48	0	0	7	18	20	2	1	0.159	82, 48	0.247	>0.05
Cafer Höyük	Early PPNB	Helmer (2)	21	0	0	8	4	5	2	2	0.076	82, 21	0.333	>0.05
Cafer Höyük	Mid-PPNB	Helmer (2)	176	0	3	43	28	53	38	11	0.128	82, 176	0.182	>0.05
Aswad	Mid-PPNB	Helmer and Gourichon (3)	97	0	1	25	21	27	14	9	0.064	82, 97	0.204	>0.05
Tell Halula 5	Mid-PPNB	Sana Segui, in Helmer et al. (4)	133	9	12	39	30	25	14	4	0.146	82, 133	0.191	>0.05
Karain B 1	EPI	Atıcı 2009	93	0	16	11	18	21	25	2	0.100	93, 82	0.206	>0.05
Karain B 2	EPI	Atıcı 2009	46	0	4	11	7	12	11	1	0.100	46, 82	0.25	>0.05
Öküzini 2	EPI	Atıcı 2009	85	1	10	17	10	24	20	3	0.101	85, 82	0.211	>0.05
Öküzini 3	EPI	Atıcı 2009	40	2	9	8	3	7	10	1	0.201	40, 82	0.262	>0.05

*Values had to be estimated from published graphs, as primary data not given.

1. Peters J, Buitenhuis H, Grupe G, Schmidt K, Pöllath N (2013) *The Origins and Spread of Domestic Animals in Southwest Asia and Europe*, eds Colledge S, et al. (Left Coast Press, Walnut Creek, CA), pp 83–114.
2. Helmer D (2008) in *Archaeozoology of the Near East VIII: Proceedings of the 8th International Symposium on the Archaeozoology of Southwestern Asia and Adjacent Areas*, eds Vila E, et al. (Maison de l'Orient et de la Méditerranée, Lyon), pp 169–195.
3. Helmer D, Gourichon L (2008) in *Archaeozoology of the Near East VIII: Proceedings of the 8th International Symposium on the Archaeozoology of Southwestern Asia and Adjacent Areas*, eds Vila E, et al. (Maison de l'Orient et de la Méditerranée, Lyon), pp 120–151.
4. Helmer D, Gourichon L, Vila E (2007) The development of the exploitation of products from *Capra* and *Ovis* (meat, milk, and fleece) from the PPNB to the Early Bronze Age in the northern Near East (8700-9200 cal BP). *Anthropozoologica* 42(2):41–69.

Table S8. Micromorphology observations on 24 samples from Trench 4GH, collected from upper Level 4 during active excavations and from the contact between Levels 4 and 3 exposed in profiles from previous excavations

Architectural feature	Context	Level	No. samples	Intact dung?	Reworked dung?	Interpretation
Building 6	Hearth	4	1	No	Yes, abundant and burned (Fig. S3*D*)	Dung was used as fuel
Building 6	Mortar	4	1	No	Yes, low abundance (Fig. S3*E*)	Dung was incorporated into mortar with other anthropogenic refuse
Building 6	Occupation debris on top of floors	4	2	No	Yes, low abundance, burned and not burned	Dung was brought into the structure for use as fuel and was deposited on top of the floors along within other materials
Building 3	Mortar	4	1	No	Yes, low abundance	Dung was incorporated into mortar with other anthropogenic refuse
Building 3	Occupation debris and fill on top of floors	4	3	No	Yes, low abundance	Dung was brought into the structure for use as fuel and was deposited on top of the floors along within other materials; mortar containing dung became incorporated into fill
Building 2	Occupation debris and fill on top of floors	4	3	Localized (mm-scale)	Yes, high abundance in discrete layer (7–10 mm thick, Fig. S3 *G* and *H*), absent from generalized fill	Dung was used as a floor covering or surface within the structure; or dung was deposited as a result of stabling within the structure and became reworked in place
Building 2	Mortar	4	1	No	No	Dung was not incorporated into the mortar in this building
Spaces 1, 7, 13	Open space, activity areas	4	5	Yes, thin layers (mm-scale), variable degree of decomposition, interbedded with other materials	Yes, mixed into general anthropogenic debris	Spaces 1 and 7 were used extensively as work areas based on artifactual evidence; livestock periodically (briefly) were kept in the open spaces as well; space 13 mainly fill but patches of intact dung residues present
Space 1	Post mold	4	1	Yes, discrete layers filling a post mold	Yes, mixed into general anthropogenic debris	The open space was partially covered; upon removal of the post, livestock periodically were kept here
Above space 1	Open space, midden	4/3	1	Yes, multiple thick layers (totaling 7+ cm thickness, lateral extent of multiple meters, Fig. S3 *B* and *C*), highly decomposed	Yes, mixed into general anthropogenic debris interbedded with intact dung	Livestock were kept in this area; increase in abundance of animals or duration of penning relative to earlier phases (spaces 1–13)
Midden area	Open space, midden	4/3C	1	Yes, one thick layer (7 cm) (Fig. S3*F*), good preservation	No	Livestock were kept in this area
Midden area	Open space, midden	4/3C	1	No	Yes, burned and in layer containing charcoal, ashes and food debris; as clumps in other refuse, not burned	Dumping of hearth contents in the midden; use of dung as fuel; aggregates of dung in refuse
Midden area	Open space, midden	3E/3D	2	Yes, one burned layer (5 mm) containing charred plant fibers, phytoliths and spherulites, multiple layers, not burned (totaling 3+ cm)	Yes, burned and in layer containing charcoal, ashes and food debris	Use of midden area for keeping livestock, with occasional burning of the dung in place; dumping of hearth contents in the midden; use of dung as fuel

See Fig. S3 for criteria for the identification of intact dung, burned dung, and decomposition.