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Wild monkeys flake stone tools

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Our understanding of the emergence of technology shapes how we view the origins of humanity[1,2]. Sharp-edged stone flakes, struck from larger cores, are the primary evidence for the earliest stone technology[3]. Here we show that wild bearded capuchin monkeys (*Sapajus libidinosus*) in Brazil deliberately break stones, unintentionally producing recurrent, conchoidally fractured, sharp-edged flakes and cores that have the characteristics and morphology of intentionally produced hominin tools. The production of archaeologically visible cores and flakes is therefore no longer unique to the human lineage, providing a comparative perspective on the emergence of lithic technology. This discovery adds an additional dimension to interpretations of the human Palaeolithic record, the possible function of early stone tools, and the cognitive requirements for the emergence of stone flaking.

Palaeoanthropologists use the distinctive characteristics of flaked stone tools both to distinguish them from naturally broken stones and to interpret the behaviour of the hominins that produced them[4]. Suggested hallmarks of the earliest stone tool technology include (i) controlled, conchoidal flaking[5];(ii) production of sharp cutting edges[6]; (iii) repeated removal of multiple flakes from a single core; (iv) clear targeting of core edges; and (v) adoption of specific flaking patterns[7]. These characteristics underlie the identification of intentional stone flaking at all early archaeological sites[3,5,7–12], as they do not co-occur under natural geological conditions.

To date, comparisons between hominin intentional stone flaking and wild primate stone tool use have focused on West African chimpanzees (*Pan troglodytes verus*)[13–16]. Nevertheless, stone breakage during chimpanzee tool use is accidental[15], a result of missed hits or indirect force application during activities such as nut-cracking. The resulting stone fragments lack most of the diagnostic criteria listed above for hominin flakes[10,17]. Even when the manufacture of sharp edges was taught to captive bonobos (*Pan paniscus*), the resulting flaked assemblage did not replicate the early hominin archaeological record[18].

The capuchins of Serra da Capivara National Park (SCNP) in Brazil use stone tools in more varied activities than any other known non-human primate, including for pounding foods, digging and in sexual displays[19–21]. Bearded capuchins and some Japanese macaques (*Macaca fuscata)* are known to pound stones directly against each other[22], but the SCNP capuchins are the only wild primates that do so for the purpose of damaging those stones[19]. This activity, which we term stone on stone (SoS) percussion, typically involves an individual selecting rounded quartzite cobbles from a conglomerate bed (active hammers), and with one or two hands striking the hammer-stone forcefully and repeatedly on quartzite cobbles embedded within the conglomerate (passive hammers) (Fig. 1, Supplementary Video 1).

Previous observations of capuchin stone percussion indicate that this behaviour occurs in an aggressive context[23]. In our observations, however, the monkeys licked or sniffed the crushed passive hammers in about half of the SoS percussion events[19] (Supplementary Video 1), suggesting that they may be ingesting either powdered quartz or lichens. While the stones do not contain any biologically active components[19], silicon is known to be an essential trace nutrient[24]. SCNP capuchins have also been seen to use a stone hammer to dislodge another stone from the conglomerate, with the second stone then used as a hammer for SoS percussion[20].

As well as deliberately crushing the surface of both the active and passive hammers, the capuchins regularly unintentionally fracture the stones during use (Supplementary Video 1). In addition, we observed a capuchin place a newly fractured stone flake on top of another stone, and then strike it with a hammer in a manner resembling chimpanzee nut-cracking or human bipolar reduction (Supplementary Video 1). Nevertheless, while the monkeys were seen to re-use broken hammer-stone parts as fresh hammers, they were not observed using the sharp edges of fractured tools to cut or scrape other objects.

We collected fragmented stones immediately after capuchins were observed using them at the Oitenta site in SCNP (8° 52.394′ S, 42° 37.971′ W) (Fig. 1), as well as from surface surveys and archaeological excavation in the same area (Extended Data Fig. 1). The assemblage consists of 111 capuchin-modified stone artefacts, including complete

Figure 1 | Wild bearded capuchin SoS percussion, Serra da Capivara National Park, Brazil. a, The conglomerate outcrop where SoS percussive behaviour of **b** and **c** was observed. **b**, **c**, SoS percussive actions including close observation by a juvenile capuchin (**b**), and stone breakage (**c**). Note that the active hammer in use is part of Refit Set 6 (Supplementary Information and Supplementary Video 1).

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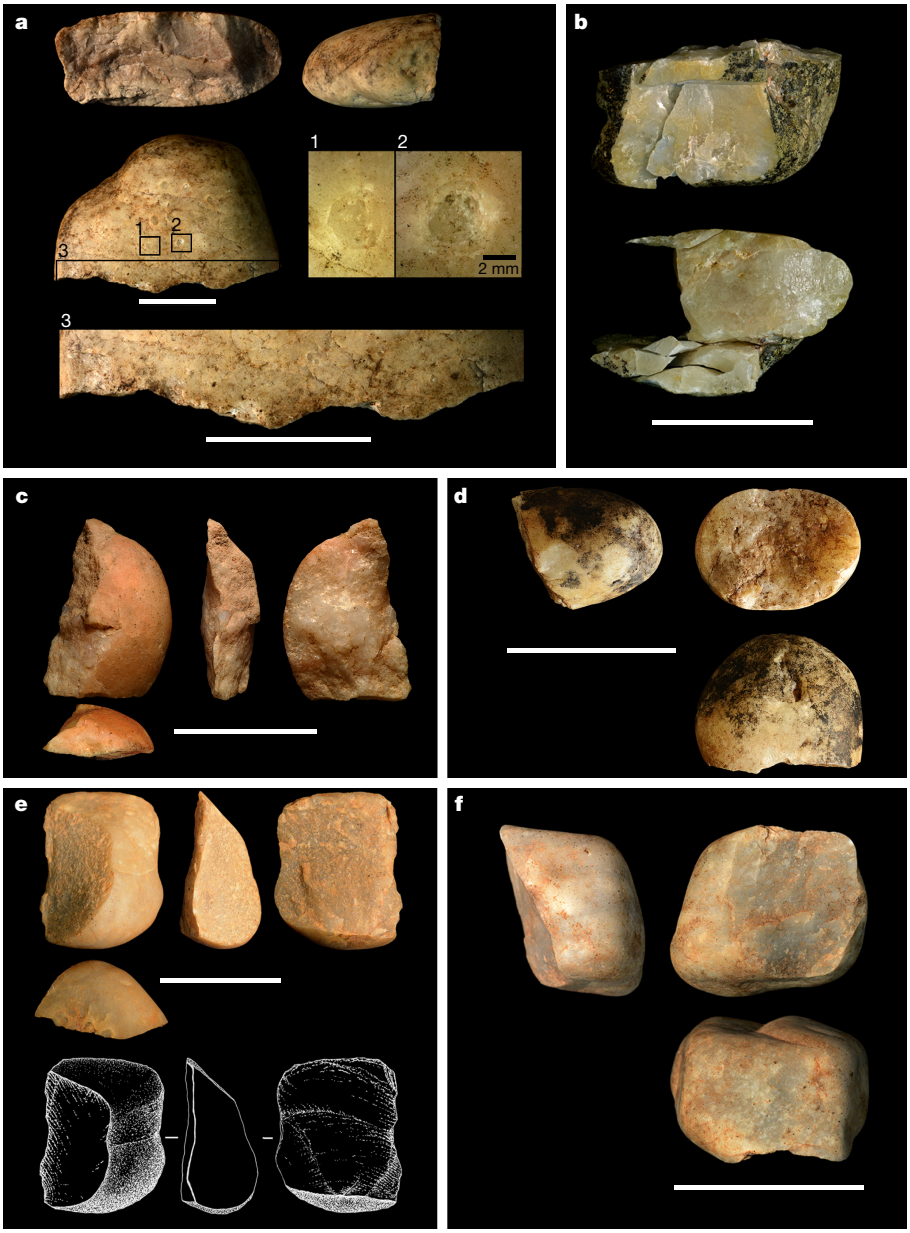

Figure 2 | Examples of flaked stones from capuchin SoS percussion. **a**, Detail of a large, unidirectionally flaked active hammer-stone, with clear impact marks located towards the centre of the striking platform. **b**, Refitted active hammer illustrating recurrent unidirectional removal of at least seven flakes (Refit Set 6; Extended Data Fig. 6b and Supplementary Video 2). **c**, **e**, Examples of conchoidal flakes. Artefact illustrations in **e** reproduced with permission from A. Theodoropoulou. **d**, **f**, Examples of flaked hammer-stones. **a**–**f**, Scale bars are 5 cm, except for the scale bar in the inset (**a**), which is 2 mm.

and broken hammer-stones, complete and fragmented flakes, and passive hammers. We also found flaked hammer-stones, which using a traditional classification would be considered flaked artefacts[25] (Extended Data Table 1). All stones were originally obtained by the capuchins from conglomerates in the vicinity of their use.

Complete hammer-stones have a mean weight of 600.3 g (Extended Data Table 2a). They possess varying degrees of percussive damage across their surfaces, including small impact points surrounded by circular or crescent scars (Supplementary Information and Extended Data Fig. 2). Broken hammer-stones and flaked hammer-stones comprise over a quarter of the total assemblage. Broken hammer-stones are on average smaller than complete hammer-stones (mean = 203.8 g; Extended Data Table 2a), and some would be termed split cobbles in a hominin assemblage. Flaked hammer-stones exhibit one or more conchoidal or wedge flake scars, occurring either as 1–2 fortuitous scars from a natural striking platform, or as recurring unidirectional, overlapping flakes resulting from repeated strikes on a fracture plane (Fig. 2, Supplementary Information and Extended Data Fig. 3). Refitted hammer-stones demonstrate this reduction sequence (Supplementary Information and Extended Data Figs 4, 5). Continuous rotation and manipulation of the hammer-stones during use also produces small (<1 cm), non-invasive, step-terminating flake scars along the edge of the striking platform, perpendicular to the flaking surface. These artefacts are indistinguishable from some archaeological examples of intentionally flaked early hominin stone cores. Using a traditional classification, the flaked hammer-stones fall within the morphology of unifacial choppers[1].

Complete flakes produced during SoS percussion have sharp edges, bulbs of percussion and scars from up to three previous flake removals (Fig. 2, Supplementary Information and Extended Data Fig. 6). A high proportion of wedge-initiated flakes occur in the early stages of reduction, evidenced by an increased frequency of cortical

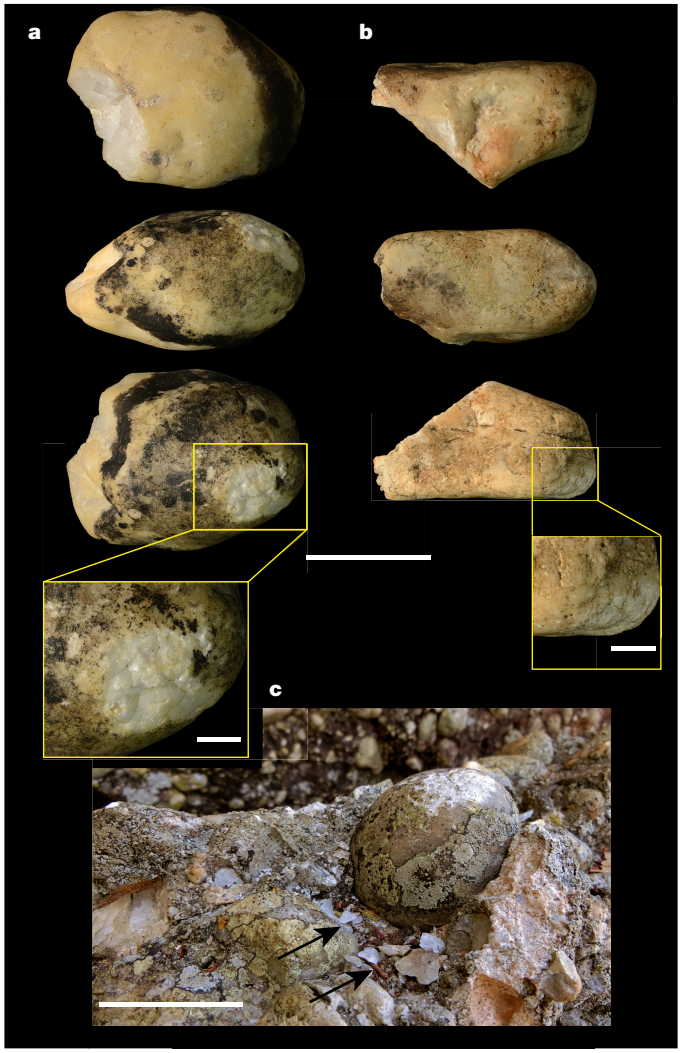

Figure 3 | Examples of passive hammers from capuchin SoS percussion. **a**, **b**, Passive hammers with detail of percussive damage (inset). **c**, Passive hammer *in situ* at Serra da Capivara National Park, after its observed use for SoS percussive behaviour. Note the small flake fragments at the base of the passive element, resulting from active hammer flaking. **a**–**c**, Main scale bars are 5 cm, the scale bars in the insets (**a**, **b**) are 1 cm.

flakes. Conchoidal flakes, on the other hand, come from both early and later stages of reduction, with both cortical and non-cortical pieces represented. Extensive refits record the production of unidirectional recurrent, conchoidal flakes following an initial forceful fracture (Extended Data Figs 5, 6, Supplementary Information and Supplementary Video 2).

Passive hammers, whether found detached from or embedded in the conglomerate, typically have a localized area of percussive damage located on a prominent surface (Fig. 3). The damage includes impact points, battering marks and crushed quartz crystals and, in some cases, detached flakes or chips. The passive hammers in this study (mean = 303.7 g, Extended Data Table 2a) also retain evidence of their subsequent re-use as active hammers, with impact points located on previously embedded flat planes opposite the passive hammer damage. This use clearly occurred after the stone was dislodged from the conglomerate. Capuchin SoS tools are therefore multifunctional, with the monkeys able to repurpose stones from a passive to an active percussive role (Supplementary Information).

The distinctive assemblages found at SoS percussion sites will guide future archaeological investigations into the development of capuchin technology at SCNP[26], and the broader Middle Pleistocene dispersal of *Sapajus* into northeast Brazil[27]. They should also assist in distinguishing human tools from capuchin artefacts where the ranges of these primates overlap[12]. Of interest beyond *Sapajus* behavioural evolution, SCNP capuchins produce stone debris through a similar technique (passive hammer) to that inferred from some of the earliest hominin archaeological assemblages[3,11]. The passive hammer knapping technique involves striking a hammer-stone onto a passive anvil, with the desired flakes detached from the hand-held stone[11] (Supplementary Video 1). Both active and passive hominin hammers often have repeated impact marks away from the tool's edge, interpreted as evidence of poorly controlled strikes or multi-purpose tool use[3]. SCNP capuchin behaviour demonstrates that these marks and recurrent conchoidally fractured, sharp-edged flakes, can be produced entirely unintentionally.

The SCNP data provide an example of repeated conchoidal flaking that is not reliant on advanced, human-like hand morphologies and coordination[28]. Similarly, SoS behaviour presents an alternative to evolutionary explanations that link the origins of recurrent flake production to a change in hominin cognitive skills[28,29]. In the absence of supporting evidence such as cut-marked bones, we suggest that sharp-edged flake production can no longer be implicitly or solely associated with intentional production of cutting flakes. Capuchin SoS percussion and simple Pliocene–Pleistocene stone knapping activities are equifinal behaviours in the production of flaked lithic assemblages. These findings open up the possibility that unintentional flaked assemblages may be identified in the palaeontological record of extinct apes and monkeys. In light of this possibility, criteria commonly used to distinguish intentional hominin lithic assemblages need to be refined.

No living primate is a direct substitute for extinct hominins, which varied in unknown ways from the behaviour, cognition and morphology seen in extant animals and humans[15]. However, capuchin SoS percussion is an example of intentional stone breakage by a non-human primate that produces concentrated lithic accumulations. Capuchin SoS percussion flakes and flaked hammer-stones fall within the range of mean dimensions for simple flakes and cores from the Early Stone Age[3] (Supplementary Information and Extended Data Table 2b). If encountered in a hominin archaeological context, this material would be identified as artefactual, potentially interpreted as the result of intentional stone fracture and controlled flake production, and probably attributed to functional needs requiring the use of sharp edges.

The capuchin data add support to an ongoing paradigm shift in our understanding of stone tool production and the uniqueness of hominin technology. Within the last decade, studies have shown that the use[30] and intentional production[3] of sharp-edged flakes is not necessarily tied to the genus *Homo*. Capuchin SoS percussion goes a step further, demonstrating that the production of archaeologically identifiable flakes and cores, as currently defined, is no longer unique to the human lineage.

Online Content Methods, along with any additional Extended Data display items and Source Data, are available in the online version of the paper; references unique to these sections appear only in the online paper.

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Supplementary Information is available in the online version of the paper.

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Author Contributions M.H. and T.F. observed and recorded the capuchin behaviour, collected lithic material and directed excavations at Serra da Capivara National Park. T.P. conducted the technological analysis. T.P., L.V.L., I.D.L.T. and M.H. discussed the implications of the results. T.P. wrote the paper and supplementary online content with contributions from L.V.L., T.F., E.B.O., I.D.L.T. and M.H. T.P generated all figures, 3D models and video content, using data recorded by M.H. and T.P.

Author Information Reprints and permissions information is available at www.nature.com/reprints. The authors declare no competing financial interests. Readers are welcome to comment on the online version of the paper. Correspondence and requests for materials should be addressed to T.P. (tomos.proffitt@arch.ox.ac.uk) or M.H. (michael.haslam@arch.ox.ac.uk).

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METHODS

The SoS percussion assemblage included 111 artefacts collected from surface and archaeological capuchin activity locations in Serra da Capivara National Park (SCNP), PIauí, Brazil. The surface collection (Lasca OIT surface; $n = 60$, 54.1%) was produced by capuchins observed performing SoS percussion in September 2014, at a site later designated Lasca Oitente 2 (Lasca OIT 2). The capuchins belong to the Jurubeba group, which was first studied in March 2004 (ref. 20). SoS activity primarily took place on a low (approximately 1 m high), narrow conglomerate ridge associated with a much larger conglomeratic outcrop (Fig. 1; Supplementary Video 1). During this time a portion of the used assemblage dropped to the ground immediately below the activity area, and was collected once the activity ceased. Additional material was collected during surface surveys within the immediate vicinity of Lasca OIT 2, at locations where isolated conglomerate blocks were used by the same capuchin group for SoS percussion. This material was also analysed as Lasca OIT surface.

The archaeological material comes from two excavations conducted in June 2015 (Extended Data Fig. 1), within the Jurubeba group range: Lasca OIT 1 (8° 52.460′ S, 42° 37.977′ W) and Lasca OIT 2 (8° 52.394′ S, 42° 37.971′ W). We excavated both sites by hand in 5-cm levels, and sieved all sediment through a 5 mm mesh. Sediments at both sites consisted of light-brown, silty sand, with gravel to cobble-sized inclusions, resulting from the *in situ* weathering of local conglomerates. We distinguished capuchin tools from natural stones on the basis of percussion marks and flaking features as described in the main text and below. The Lasca OIT 2 excavation (Extended Data Fig. 1b) can be considered an extension of the surface material collected in 2014 from the same site. An area of 3 m^2 excavated to a maximum depth of 0.5 m yielded 28 SoS percussion artefacts (25.2%) at Lasca OIT 2. We excavated Lasca OIT 1 (Extended Data Fig. 1a), located 120 m southwest of Lasca OIT 2, beneath the sheer face of an approximately 7 m high conglomerate outcrop that showed percussion marks indicative of previous SoS activity. A total excavated area of 3 m^2 to a maximum depth of 0.4 m yielded 23 artefacts (20.7%) at this site. We did not find human material, such as hearths, ceramic pieces, metal objects, or ground stone at either site. Such items are ubiquitous in anthropogenic sites elsewhere in SCNP[31]. This absence, along with direct observation of capuchins creating the flaked surface assemblage, and the identical nature of the damage and size of the recovered stones to those observed in use by capuchins, rules out human production of the archaeological material.

No statistical methods were used to predetermine sample size. The experiments were not randomized. The investigators were not blinded to allocation during experiments and outcome assessment.

We identified the raw material of each artefact and performed technological classification and analysis following commonly used technological attributes[7,9,32,33]. For full details and definitions of the technological categories used in this analysis, see the Supplementary Information. All data are available upon request.

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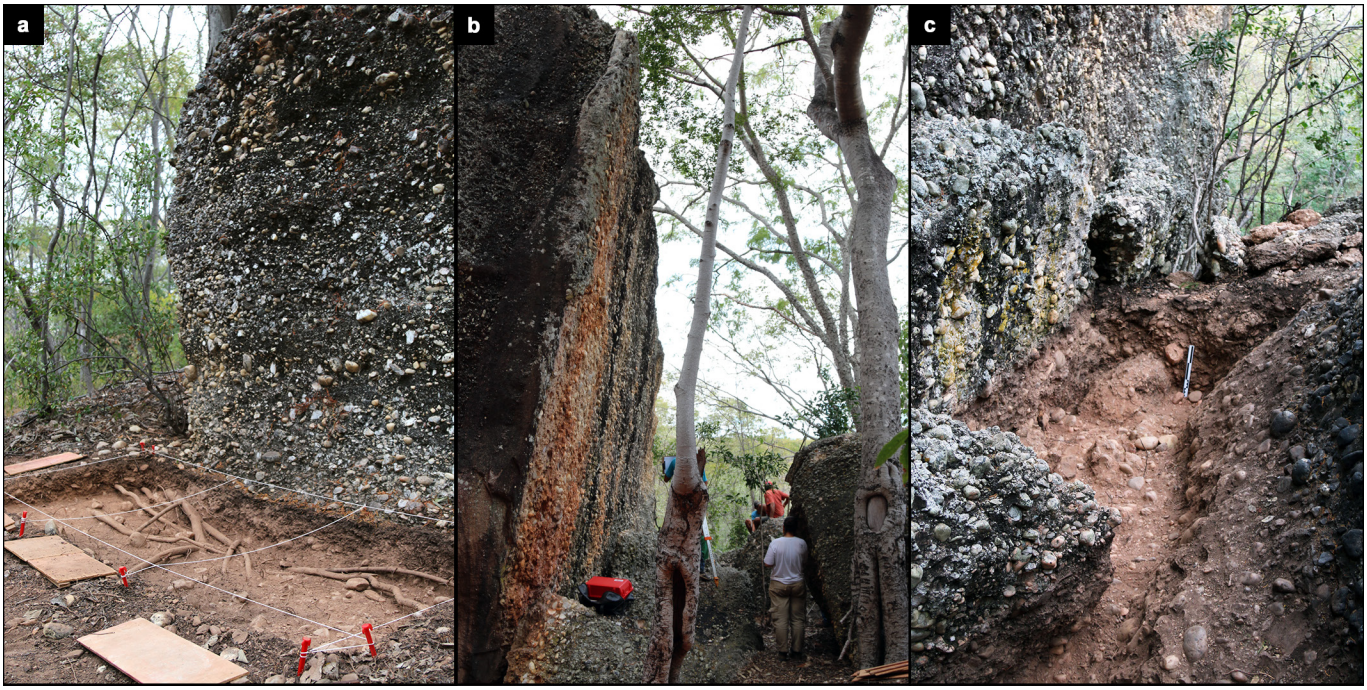
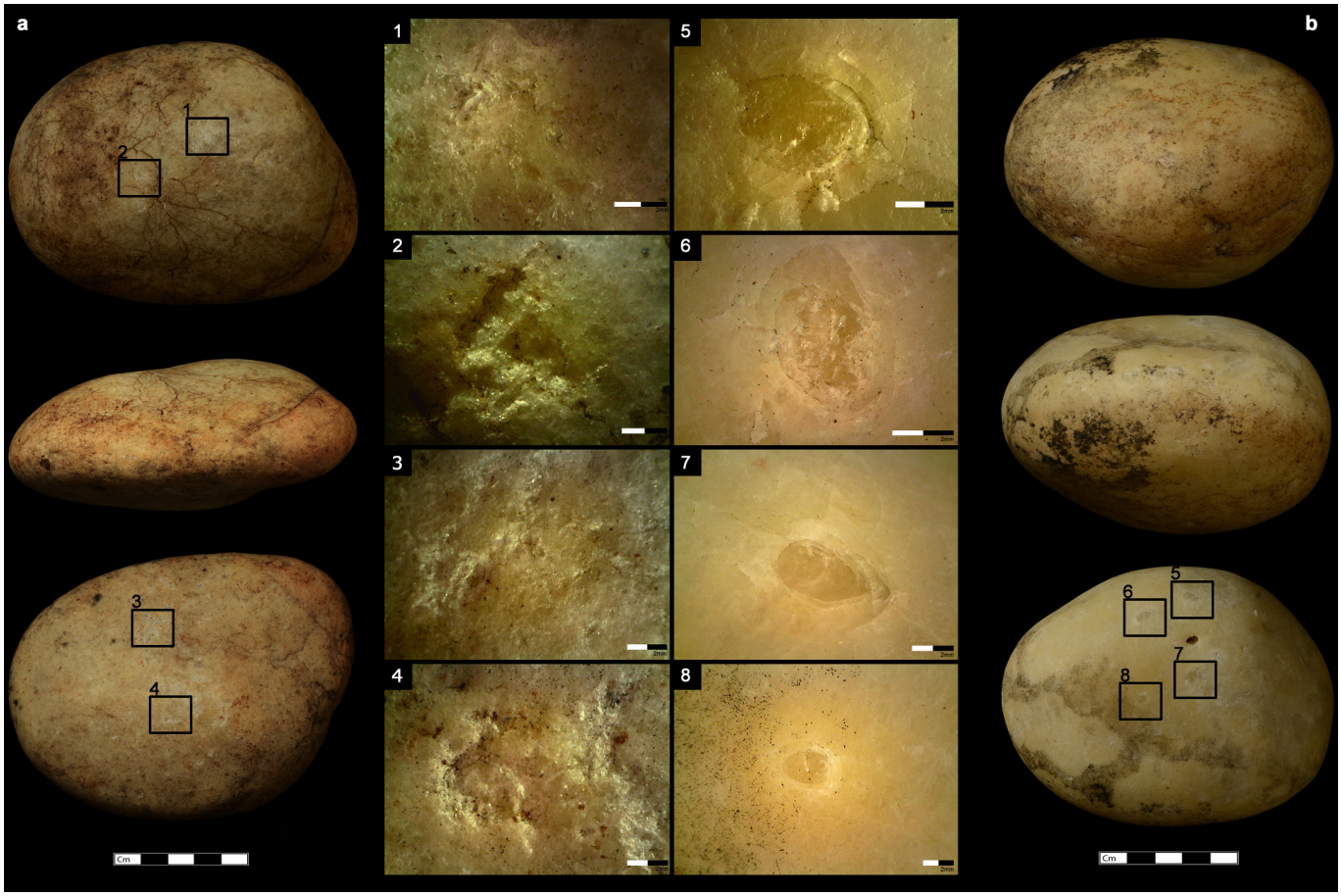
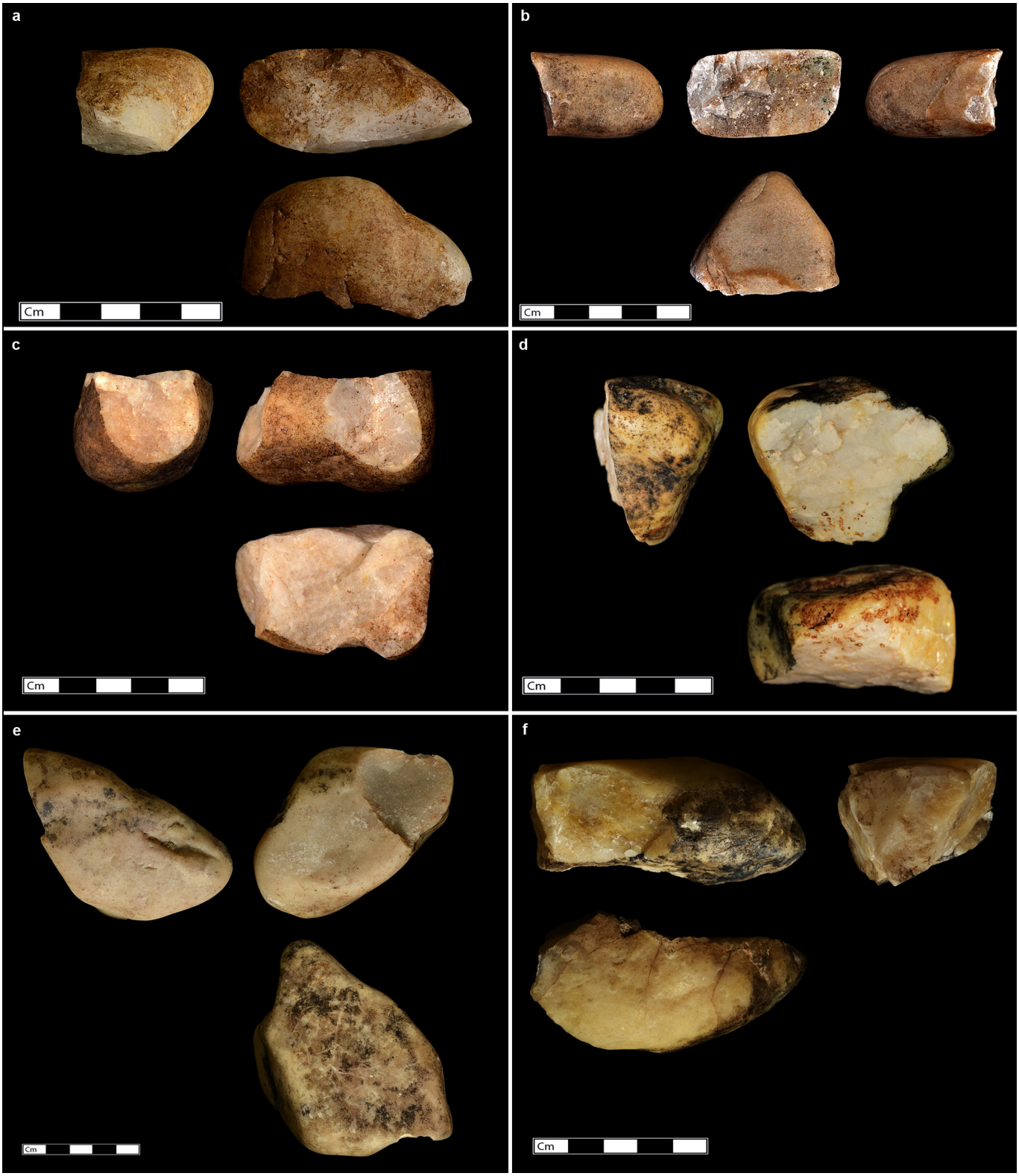


Extended Data Figure 1 | Archaeological excavation of wild capuchin SoS percussion sites, Serra da Capivara National Park. a, Lasca OIT1 excavation, each square is 1 × 1 m. **b**, The approach to Lasca OIT2, which is located to the right of the conglomerate cliff face. **c**, Lasca OIT2 excavation, note the low conglomerate ridge to the left, on which capuchins were observed whilst performing SoS activities. Scale bar, 30 cm (see also Fig. 1).

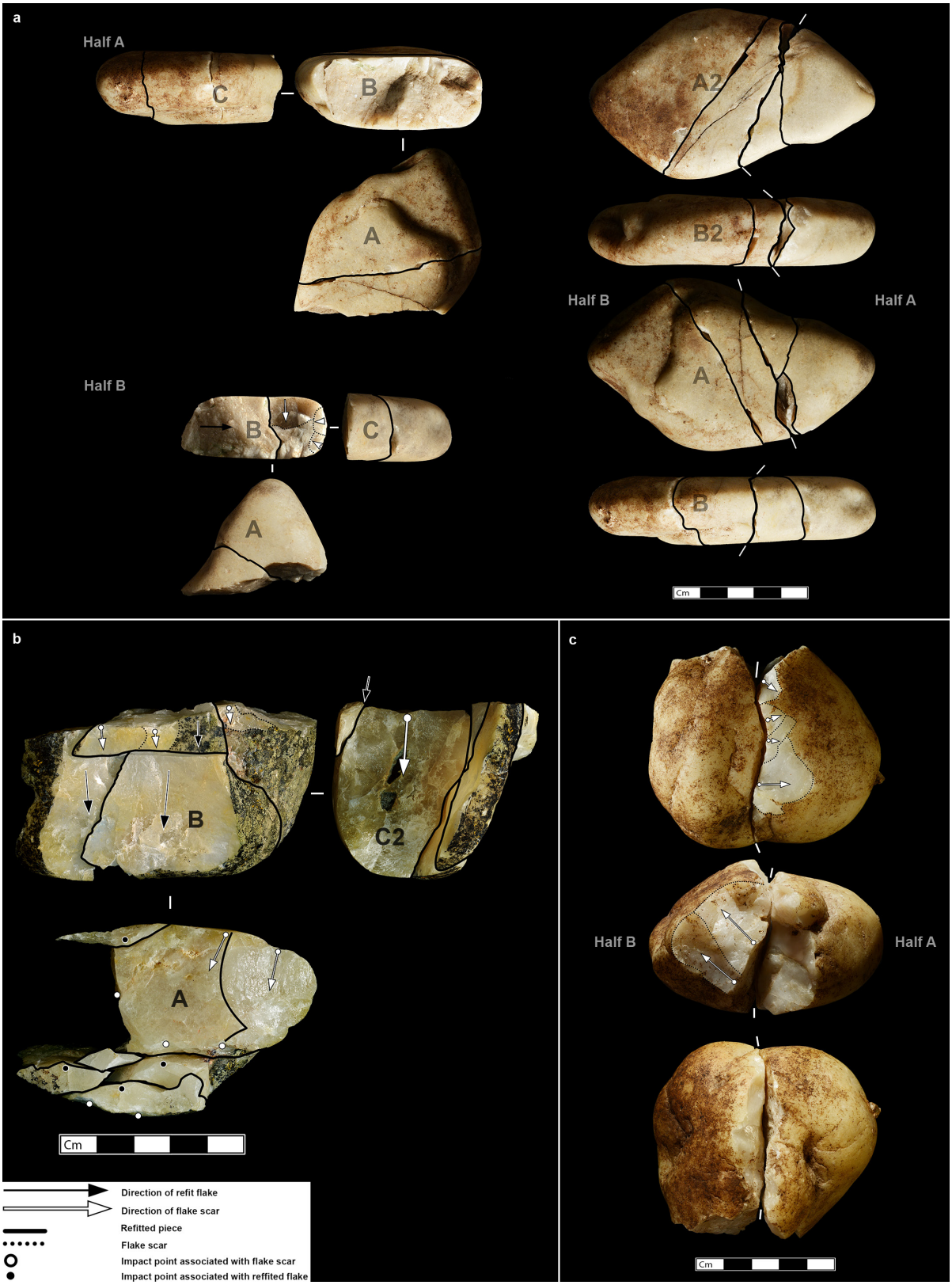


Extended Data Figure 2 | Examples of active hammers. a, Crushing impacts on multiple surfaces of an active hammer. **b**, Examples of impact points and associated circular hertzian fractures on the surface of an active hammer. Scale bars are 5 cm, except for inset scale bars, which are 2 mm.



Extended Data Figure 3 | Examples of SoS flaked hammer-stones. a, **c**, Flake detachment following a transverse active hammer fracture. **b**, Unintentional radial reduction of flaked hammer-stone. **d**–**f**, Examples of complete active hammers with scars of accidental flakes. Scale bars are 5 cm.

Extended Data Figure 4 | Refits of flaked hammer-stones showing the repeated detachment of unidirectional flakes. a, Refit Set 1 (artefact numbers JC13 and JF7). **b**, Refit Set 2 (artefact numbers 225102a and 225102b). **c**, Refit Set 3 (artefact numbers 224881a and 224881b). **d**, Refit Set 4 (artefact numbers JF3 and JC5). A, A2, B and C are designated planes on each refit, corresponding to descriptions found in Supplementary Information. Scale bars are 5 cm.



Extended Data Figure 5 | Refits of flaked hammer-stones showing the repeated detachment of unidirectional flakes and continued use of broken active hammers. a, Refit Set 5 (artefact numbers JC11, JC12, JF23 and JF1). **b**, Refit Set 6 (artefact numbers JC6, JF2, JF14, JF4 and JF8) (See also Supplementary Video 2). **c**, Refit Set 7 (artefact numbers JC4 and JC10). A, A2, B, B2, C and C2 are designated planes on each refit, corresponding to descriptions found in Supplementary Information. Scale bars are 5 cm.

Extended Data Figure 6 | Examples of complete flakes. a–f, Examples of complete flakes detached during capuchin SoS percussion. Scale bars are in cm. Scale bars are 5 cm.

Extended Data Table 1 | Absolute and relative frequencies and total weights (g) of technological categories identified in each Capuchin SoS assemblage, Serra da Capivara National Park

	Assemblage															
	Lasca OIT Surface		Lasca OIT 1 Excavation		Lasca OIT 2 Excavation		Total		Lasca OIT Surface		Lasca OIT 1 Excavation		Lasca OIT 2 Excavation		Total	
	Frequency								Total Weight (g)							
Technological Category	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Complete Hammerstone	0	0.0	8	34.8	8	28.6	16	14.4	0	0.0	4602	58.1	5002	61.2	9605	51.7
Broken Hammerstone	4	6.7	2	8.7	6	21.4	12	10.8	697.9	27.9	570.4	7.2	1898	23.2	3166	17.0
Flaked Pieces	10	16.7	4	17.4	7	25.0	21	18.9	1297	51.8	2154	27.2	832.5	10.2	4283	23.0
Complete Flake	19	31.7	7	30.4	5	17.9	31	27.9	288.4	11.5	167.1	2.1	179.5	2.2	635	3.4
Fragmented Flake	12	20.0	1	4.3	0	0.0	13	11.7	41.8	1.7	27	0.3	0	0.0	68.8	0.4
Chunk	13	21.7	0	0.0	1	3.6	14	12.6	178.3	7.1	0	0.0	51.1	0.6	229.4	1.2
Small Debris	2	3.3	0	0.0	0	0.0	2	1.8	1.4	0.1	0	0.0	0	0.0	1.4	0.0
Passive Element	0	0.0	1	4.3	1	3.6	2	1.8	0	0.0	398.3	5.0	209.1	2.6	607.4	3.3
Total	60	100	23	100	28	100	111	100	2505	100	7919	100	8172	100	18595	100

Extended Data Table 2 | Dimensional data for all artefacts from Capuchin SoS assemblages and a comparison with Pliocene–Pleistocene hominin artefacts

A

Technological Category	Measure	Assemblage															
		Lasca OIT Surface				Lasca OIT 1 Excavation				Lasca OIT 2 Excavation				Total			
		Min	Max	Mean	St.Dev	Min	Max	Mean	St.Dev	Min	Max	Mean	St.Dev	Min	Max	Mean	St.Dev
Hammerstone	Max Length (mm)	-	-	-	-	75.00	129.00	101.15	19.35	61.70	149.50	104.89	27.19	61.70	149.50	103.02	22.88
	Max Width (mm)	-	-	-	-	53.90	93.70	77.16	12.02	48.80	126.40	76.90	24.56	48.80	126.40	77.03	18.68
	Max Thickness (mm)	-	-	-	-	39.70	74.90	54.63	11.05	40.00	74.80	54.34	14.30	39.70	74.80	54.48	12.35
	Weight (g)	-	-	-	-	261.50	924.20	575.30	231.89	155.40	1569.00	625.28	469.54	155.40	1569.00	600.29	358.67
Broken Hammerstone	Max Length (mm)	48.16	92.58	77.33	20.24	75.10	101.70	88.40	18.81	50.90	108.10	94.18	22.17	48.16	108.10	87.60	20.72
	Max Width (mm)	30.91	61.66	43.65	13.92	43.60	67.10	55.35	16.62	28.00	76.20	55.25	16.29	28.00	76.20	51.40	15.21
	Max Thickness (mm)	18.87	42.87	34.46	11.03	42.10	57.60	49.85	10.96	14.00	60.90	44.18	17.01	14.00	60.90	41.89	14.49
	Weight (g)	37.80	286.30	174.48	102.87	187.40	383.00	285.20	138.31	26.90	604.90	316.25	194.21	26.90	604.90	263.82	162.03
Flaked Pieces	Max Length (mm)	42.97	81.52	64.81	12.22	85.50	137.50	101.23	24.45	43.00	101.40	64.76	21.38	42.00	137.50	71.73	22.56
	Max Width (mm)	35.52	57.01	44.98	6.94	41.30	99.50	67.08	24.52	32.00	47.00	39.53	5.48	32.00	99.50	47.37	14.93
	Max Thickness (mm)	23.38	45.29	35.79	8.48	33.90	77.80	56.33	18.11	22.50	43.60	32.64	7.87	22.50	77.80	38.65	13.39
	Weight (g)	48.90	247.00	129.69	53.44	136.70	1101.00	538.40	412.77	62.60	265.40	118.93	79.26	48.90	1101.00	203.95	237.45
Complete Flakes	Max Length (mm)	14.80	70.98	34.95	16.69	29.90	63.60	44.34	11.17	30.20	65.80	49.70	12.72	14.80	70.98	39.45	15.80
	Max Width (mm)	6.00	45.70	22.48	11.72	23.70	44.70	31.54	8.02	16.50	52.40	34.66	15.39	6.00	52.40	26.49	12.42
	Max Thickness (mm)	1.60	27.56	12.03	7.34	6.90	24.90	13.57	6.54	11.10	33.50	16.94	9.32	1.60	33.50	13.17	7.46
	Weight (g)	.10	44.70	15.18	16.15	4.80	59.20	23.87	23.79	9.90	108.60	35.90	41.51	.10	108.60	20.48	23.65
Fragmented Flakes	Max Length (mm)	13.04	41.75	21.32	9.49	79.30	79.30	79.30	-	-	-	-	-	13.04	79.30	25.78	18.47
	Max Width (mm)	7.05	24.42	13.37	4.93	28.60	28.60	28.60	-	-	-	-	-	7.05	28.60	14.54	6.33
	Max Thickness (mm)	3.71	19.92	6.96	4.64	14.60	14.60	14.60	-	-	-	-	-	3.71	19.92	7.55	4.93
	Weight (g)	.40	26.00	3.48	7.18	27.00	27.00	27.00	-	-	-	-	-	.40	27.00	5.29	9.48
Chunk	Max Length (mm)	12.63	57.31	26.74	13.33	-	-	-	-	70.40	70.40	70.40	-	12.63	70.40	29.86	17.32
	Max Width (mm)	9.89	55.32	19.48	12.39	-	-	-	-	38.00	38.00	38.00	-	9.89	55.32	20.81	12.89
	Max Thickness (mm)	7.01	33.54	13.60	7.38	-	-	-	-	25.00	25.00	25.00	-	7.01	33.54	14.41	7.72
	Weight (g)	.70	83.00	13.72	24.10	-	-	-	-	51.10	51.10	51.10	-	.70	83.00	16.39	25.22
Small Debris	Max Length (mm)	14.03	14.38	14.21	.25	-	-	-	-	-	-	-	-	14.03	14.38	14.21	.25
	Max Width (mm)	6.22	8.36	7.29	1.51	-	-	-	-	-	-	-	-	6.22	8.36	7.29	1.51
	Max Thickness (mm)	5.23	8.11	6.67	2.04	-	-	-	-	-	-	-	-	5.23	8.11	6.67	2.04
	Weight (g)	.60	.80	.70	.14	-	-	-	-	-	-	-	-	.60	.80	.70	.14
Passive Hammers	Max Length (mm)	-	-	-	-	90.20	90.20	90.20	-	85.3	85.3	85.3	-	85.30	90.20	87.75	3.46
	Max Width (mm)	-	-	-	-	68.70	68.70	68.70	-	53.7	53.7	53.7	-	53.70	68.70	61.20	10.61
	Max Thickness (mm)	-	-	-	-	50.50	50.50	50.50	-	38.1	38.1	38.1	-	38.10	50.50	44.30	8.77
	Weight (g)	-	-	-	-	398.30	398.30	398.30	-	209.1	209.1	209.1	-	209.10	398.30	303.70	133.78
Natural/Unmodified	Max Length (mm)	-	-	-	-	-	-	-	-	84.20	93.90	89.05	6.86	84.20	93.90	89.05	6.86
	Max Width (mm)	-	-	-	-	-	-	-	-	78.30	82.00	80.15	2.62	78.30	82.00	80.15	2.62
	Max Thickness (mm)	-	-	-	-	-	-	-	-	35.70	44.10	39.90	5.94	35.70	44.10	39.90	5.94
	Weight (g)	-	-	-	-	-	-	-	-	271.50	463.40	367.45	135.69	271.50	463.40	367.45	135.69

B

Site	Age (Ma)	N	Length (mm)				Width (mm)				Thickness (mm)			
			Mean	Std	Min	Max	Mean	Std	Min	Max	Mean	Std	Min	Max
Flakes														
LOM3	3.3	26	120.0	48.80	19	205	110.1	40.70	19	185	43.9	23.40	6	90
OGS7	2.6	73	39.1	14.30	13	80	37.1	14.10	13	74	12.7	5.07	3	26
EG10	2.6	114	37.4	15.34	14	78	34.6	13.74	14	78	13.2	6.26	3	33
EG12	2.6	62	34.5	12.84	15	66	35.6	13.23	19	66	12.1	5.76	4	30
AL894	2.36	1048	35.9	23.63	6	134	25.1	17.57	2	106	8.0	6.40	1	45
LA2C	2.34	500	38.0	15.00	12	96	35.0	14.00	7	128	11.0	5.00	3	28
Omo57	2.34	44	24.8	10.55	10	58	20.4	6.85	10	44	7.7	4.01	1	18
Omo123	2.34	110	20.8	7.50	7	50	17.8	6.49	6	38	5.9	2.79	1	16
DK	> 1.84	115	40.2	14.80	18	111	37.4	11.22	17	71	11.9	5.40	4	29
FLKZinj	1.76-1.84	125	36.8	12.13	16	82	32.9	11.59	4	76	11.5	5.45	4	36
SCNP	**N/A**	**31**	**33.5**	**15.80**	**14.8**	**70.98**	**26.5**	**12.42**	**6**	**52.4**	**13.2**	**7.46**	**1.6**	**33.5**
Cores														
LOM3	3.3	83	167.0	23.40	132	260	147.8	23.10	90	210	108.8	21.80	61	170
OGS7	2.6	7	44.1	13.68	28	67	59.0	8.54	45	70	37.0	8.20	22	49
EG10	2.6	16	83.3	10.34	69	105	60.9	9.18	44	80	45.3	12.36	30	69
EG12	2.6	7	74.5	8.72	58	93	59.7	8.06	49	77	43.7	77.40	25	53
AL894	2.36	38	75.0	30.32	19.31	136.3	55.3	22.54	12.21	94.9	35.9	18.10	7.92	78.2
LA2C	2.34	70	66.0	18.00	39	123	52.0	14.00	32	95	32.0	12.00	12	78

a, Dimension data for all technological categories identified in this study. **b**, Metric comparison of SCNP capuchin SoS percussion flakes and flaked hammer-stones with hominin Pliocene–Pleistocene flake and core dimensions. Data and table adapted from Harmand *et al.* (2015).