Supporting Information

Sponheimer et al. 10.1073/pnas.1222579110

SI Text

Diet–Enamel Fractionation. Carbon isotope fractionation between diet and enamel is known to vary between taxa, which is one of several factors that complicate nominal percent C_4 calculations. Fractionation for most small mammals seems to be around 10‰ (1, 2), whereas fractionation for larger mammals varies between about 12‰ and 14‰ (3, 4). It has been argued that this variation is, to some extent, the product of varying degrees of methanogenesis (and the eventual expulsion of isotopically light methane), with more methanogenic organisms having higher diet–enamel fractionation (4). Trophic level also has an impact on fractionation (3). Current evidence suggests that diet–enamel fractionation for medium to large primates is around 13‰ (5), which falls in the middle of the expected range for mammals of their body size. It is possible that there was some variation in hominin diet–enamel fractionation, both between and within species (if diet varied in quality over time or space), although it would be difficult to argue that it would fall outside of the 12–14‰ range. To play with extremes, we could speculate that the C_3 consumers (e.g., *Australopithecus anamensis*) had diet–enamel fractionations of about 12‰, whereas *Paranthropus boisei*, which consumed large amounts of (likely refractory) C_4 material, was more methanogenic and had a diet–enamel fractionation of 14‰. From an interpretive standpoint, the above would mean very little, only suggesting a small reduction in the likely C_4 consumption of *P. boisei* (to perhaps 65–70% of dietary carbon), and would in no way impact the discussion herein. Nevertheless, this scenario is extremely unlikely, because the C_4-consuming taxa with which we are comparing the hominins include low-quality bulk feeders that were presumably quite methanogenic (equids). There is little reason to suppose that any hominin had even greater diet–enamel fractionation. In fact, it might well be argued that our data slightly underestimate C_4 consumption, because data from modern primates (5) suggest that most hominins had lower diet–enamel fractionations than the taxa to which they are juxtaposed here.

C_3 and C_4 Grasses. In temperate areas, such as much of Europe, the vast majority of plants, including grasses, use the C_3 photosynthetic pathway. C_4 grasses have supplanted less water-efficient C_3 grasses in most hot, dry, and sunny environments, such as the African woodlands and grasslands of principle concern here (6). Winter rainfall regions in the Cape of South Africa have C_3 grasses, and C_3 grasses can also persist in predominantly C_4 biomes in shady areas and along watercourses. In general, there is little reason to suppose that C_3 grasses were abundant in the areas where the hominins discussed herein originated, because there is little evidence that grazing herbivores consumed much C_3 grass, with some possible exceptions (e.g., some alcelaphini at Sterkfontein) (7). If C_3 grasses were more broadly distributed in the past, however, it would make the high $\delta^{13}C$ values of various hominin taxa even more remarkable, because it would mean that C_4 resources were less available for consumption than we had assumed. The bottom line is that local C_3 grass abundance would not significantly alter our interpretations here. Nevertheless, if *Paranthropus* was a grass or sedge eater and C_4 sedges/grasses were more abundant in eastern Africa than southern Africa, it could explain the divergent $\delta^{13}C$ values of *Paranthropus* in these regions.

1. DeNiro MJ, Epstein S (1978) Influence of diet on the distribution of carbon isotopes in animals. *Geochim Cosmochim Acta* 42:495–506.
2. Ambrose SH, Norr L (1993) Experimental evidence for the relationship of the carbon isotope ratios of whole diet and dietary protein to those of bone collagen and carbonate. *Prehistoric Human Bone: Archaeology at the Molecular Level*, eds Lambert JB, Grupe G (Springer, Berlin), pp 1–37.
3. Lee-Thorp JA, Sealy JC, van der Merwe NJ (1989) Stable carbon isotope ratio differences between bone collagen and bone apatite, and their relationship to diet. *J Archaeol Sci* 16:585–599.
4. Passey BH, et al. (2005) Carbon isotope fractionation between diet breadth, CO_2, and bioapatite in different mammals. *J Archaeol Sci* 32:1459–1470.
5. Cerling TE, Hart JA, Hart TB (2004) Stable isotope ecology in the Ituri Forest. *Oecologia* 138(1):5–12.
6. Vogel J, Fuls A, Ellis R (1978) The geographical distribution of Kranz grasses in South Africa. *S Afr J Sci* 74:209–215.
7. Lee-Thorp JA, Sponheimer M, Luyt J (2007) Tracking changing environments using stable carbon isotopes in fossil tooth enamel: An example from the South African hominin sites. *J Hum Evol* 53(5):595–601.

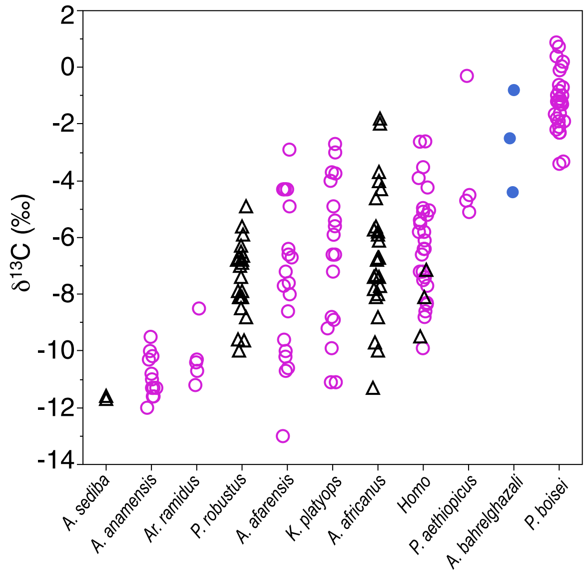

Fig. S1. Early hominin taxa from southern Africa (black triangles), eastern Africa (purple circles), and central Africa (blue filled circles) arranged from lowest to highest δ^{13}C values. Three broad groups are apparent: one group with a fairly narrow range of δ^{13}C values that falls primarily in C_3 space, one group with very high δ^{13}C values, indicating a C_4 (or less likely, CAM) -dominated isotopic niche, and one group with broad values that traverse C_3 and C_4 isotope space. All published data before 4 Ma fall largely in C_3 isotope space. Data are from refs. 1–14.

1. Lee-Thorp JA, Van der Merwe NJ, Brain CK (1994) Diet of *Australopithecus robustus* at Swartkrans from stable carbon isotopic analysis. *J Hum Evol* 27:361–372.
2. Sponheimer M, Lee-Thorp JA (1999) Isotopic evidence for the diet of an early hominid, *Australopithecus africanus*. *Science* 283(5400):368–370.
3. van der Merwe NJ, Thackeray JF, Lee-Thorp JA, Luyt J (2003) The carbon isotope ecology and diet of *Australopithecus africanus* at Sterkfontein, South Africa. *J Hum Evol* 44(5): 581–597.
4. Sponheimer M, et al. (2005) Hominins, sedges, and termites: New carbon isotope data from the Sterkfontein valley and Kruger National Park. *J Hum Evol* 48(3):301–312.
5. Lee-Thorp JA, Thackeray JF, van der Merwe NJ (2000) The hunters and the hunted revisited. *J Hum Evol* 39:565–576.
6. Lee-Thorp JA, Sponheimer M, Passey BH, de Ruiter DJ, Cerling TE (2010) Stable isotopes in fossil hominin tooth enamel suggest a fundamental dietary shift in the Pliocene. *Philos Trans R Soc Lond B Biol Sci* 365(1556):3389–3396.
7. Lee-Thorp J, et al. (2012) Isotopic evidence for an early shift to C_4 resources by Pliocene hominins in Chad. *Proc Natl Acad Sci USA* 109(50):20369–20372.
8. van der Merwe NJ, Masao FT, Bamford MK (2008) Isotopic evidence for contrasting diets of early hominins *Homo habilis* and *Australopithecus boisei* of Tanzania. *S Afr J Sci* 104: 153–155.
9. Sponheimer M, et al. (2006) Isotopic evidence for dietary variability in the early hominin *Paranthropus robustus*. *Science* 314(5801):980–982.
10. White TD, et al. (2009) Macrovertebrate paleontology and the Pliocene habitat of *Ardipithecus ramidus*. *Science* 326(5949):87–93.
11. Cerling TE, et al. (2011) Diet of *Paranthropus boisei* in the early Pleistocene of East Africa. *Proc Natl Acad Sci USA* 108(23):9337–9341.
12. Cerling TE, et al. (2013) Stable isotope-based diet reconstructions of Turkana Basin hominins. *Proc Natl Acad Sci USA*, 10.1073/pnas.1222568110.
13. Henry AG, et al. (2012) The diet of *Australopithecus sediba*. *Nature* 487(7405):90–93.
14. Wynn JG, et al. (2013) Diet of *Australopithecus afarensis* from the Pliocene Hadar Formation, Ethiopia. *Proc Natl Acad Sci USA*, 10.1073/pnas.1222559110.

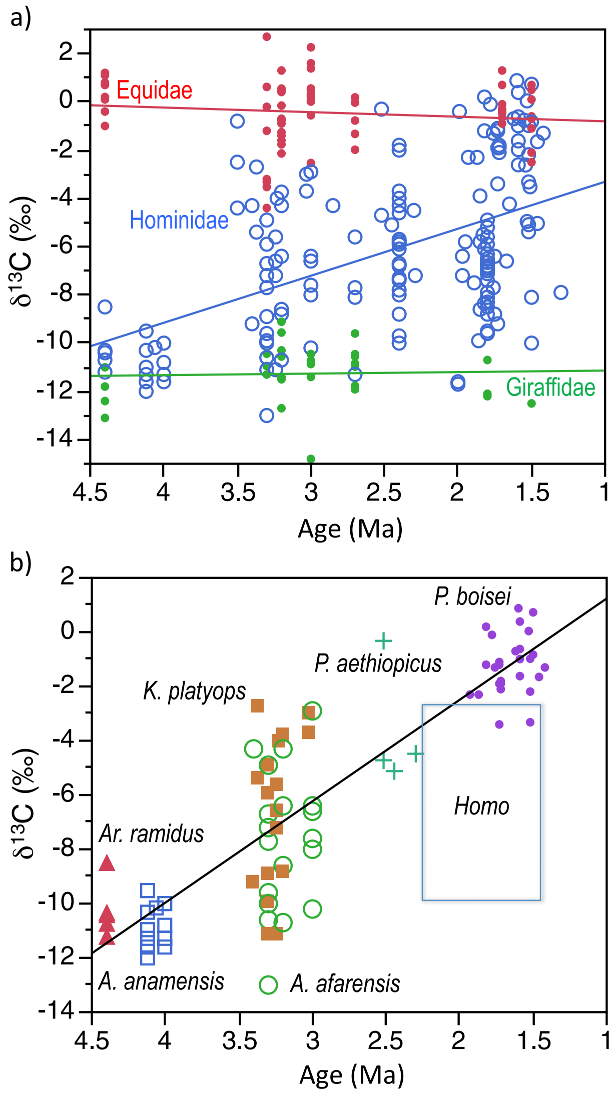

Fig. S2. (*A*) δ^{13}C values through time for Hominidae (blue open circles), Equidae (red closed circles), and Giraffidae (green closed circles) from early hominin sites with linear regression lines. There is no significant difference in mean δ^{13}C values between hominins before 4 Ma and giraffid δ^{13}C values. Giraffid and equid values do not change through time, but hominid values do change weakly [linear regression; $r^2 = 0.25$; $t(173) = -7.49$, $P < 0.001$]. (*B*) The temporal change is much clearer when looking only at the δ^{13}C values of the eastern African australopiths [linear regression; $r^2 = 0.76$; $t(85) = -16.52$, $P < 0.001$]. *Homo* deviates from the australopith regression line (black) and is shown as a box encompassing its temporal and carbon isotopic range in eastern Africa. Data are from refs. 1–14.

1. Lee-Thorp JA, Van der Merwe NJ, Brain CK (1994) Diet of *Australopithecus robustus* at Swartkrans from stable carbon isotopic analysis. *J Hum Evol* 27:361–372.
2. Sponheimer M, Lee-Thorp JA (1999) Isotopic evidence for the diet of an early hominid, *Australopithecus africanus*. *Science* 283(5400):368–370.
3. van der Merwe NJ, Thackeray JF, Lee-Thorp JA, Luyt J (2003) The carbon isotope ecology and diet of *Australopithecus africanus* at Sterkfontein, South Africa. *J Hum Evol* 44(5): 581–597.
4. Sponheimer M, et al. (2005) Hominins, sedges, and termites: New carbon isotope data from the Sterkfontein valley and Kruger National Park. *J Hum Evol* 48(3):301–312.
5. Lee-Thorp JA, Thackeray JF, van der Merwe NJ (2000) The hunters and the hunted revisited. *J Hum Evol* 39:565–576.
6. Lee-Thorp JA, Sponheimer M, Passey BH, de Ruiter DJ, Cerling TE (2010) Stable isotopes in fossil hominin tooth enamel suggest a fundamental dietary shift in the Pliocene. *Philos Trans R Soc Lond B Biol Sci* 365(1556):3389–3396.
7. Lee-Thorp J, et al. (2012) Isotopic evidence for an early shift to C_4 resources by Pliocene hominins in Chad. *Proc Natl Acad Sci USA* 109(50):20369–20372.
8. van der Merwe NJ, Masao FT, Bamford MK (2008) Isotopic evidence for contrasting diets of early hominins *Homo habilis* and *Australopithecus boisei* of Tanzania. *S Afr J Sci* 104: 153–155.
9. Sponheimer M, et al. (2006) Isotopic evidence for dietary variability in the early hominin *Paranthropus robustus*. *Science* 314(5801):980–982.
10. White TD, et al. (2009) Macrovertebrate paleontology and the Pliocene habitat of *Ardipithecus ramidus*. *Science* 326(5949):87–93.
11. Cerling TE, et al. (2011) Diet of *Paranthropus boisei* in the early Pleistocene of East Africa. *Proc Natl Acad Sci USA* 108(23):9337–9341.
12. Cerling TE, et al. (2013) Stable isotope-based diet reconstructions of Turkana Basin hominins. *Proc Natl Acad Sci USA*, 10.1073/pnas.1222568110.
13. Henry AG, et al. (2012) The diet of *Australopithecus sediba*. *Nature* 487(7405):90–93.
14. Wynn JG, et al. (2013) Diet of *Australopithecus afarensis* from the Pliocene Hadar Formation, Ethiopia. *Proc Natl Acad Sci USA*, 10.1073/pnas.1222559110.

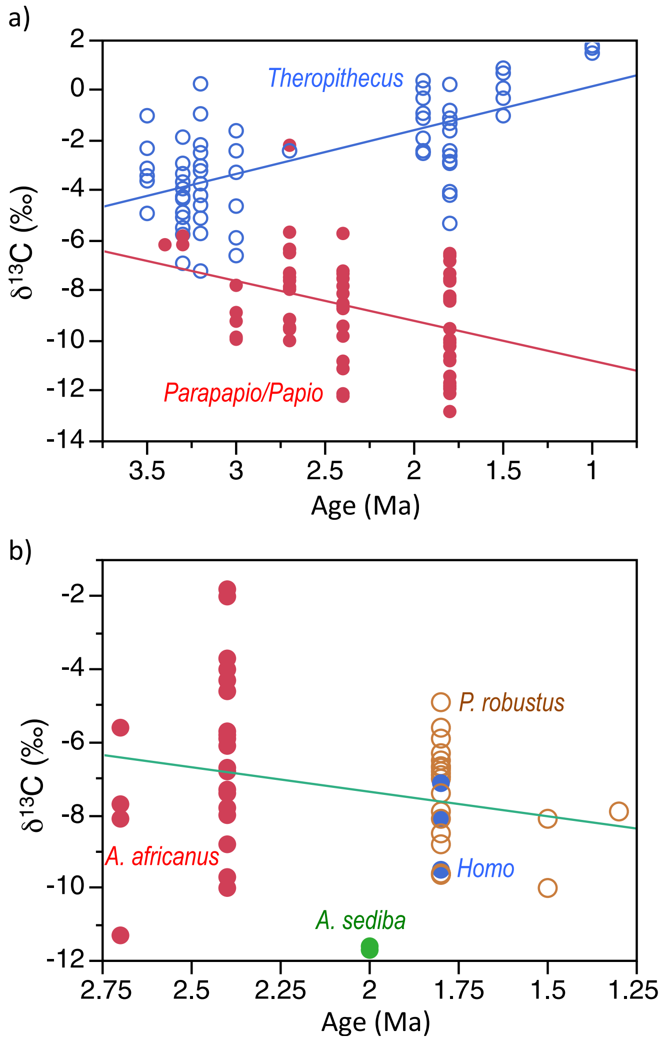

Fig. S3. (*A*) *Parapapio* and *Papio* (red filled circles/regression line) $\delta^{13}C$ values decrease weakly over time [linear regression; $r^2 = 0.15$; $t(63) = 3.26$, $P < 0.01$], whereas *Theropithecus* (blue open circles/regression line) $\delta^{13}C$ values increase [linear regression; $r^2 = 0.43$; $t(69) = -7.14$, $P < 0.001$). (*B*) There is no temporal trend among the southern African hominins, which contrasts strongly with what has been found for the hominins of eastern Africa.

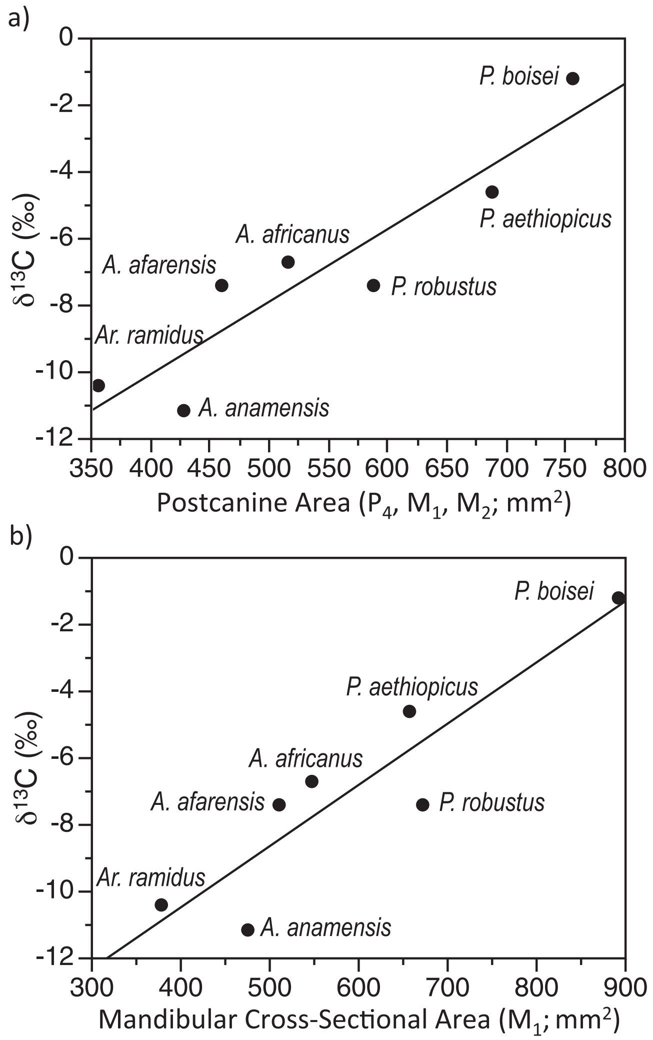

Fig. S4. (*A*) Median hominin $\delta^{13}C$ values and postcanine area [Premolar (P_4) and molar (M_1, and M_2)] data (with regression line) for taxa in this study excluding *Homo* [linear regression; $r^2 = 0.86$; $t(5) = 5.50$, $P < 0.01$]. (*B*) Median hominin $\delta^{13}C$ values and median mandibular cross-sectional area ([corpus width at M_1] × [corpus height at M_1] × [Pi/4]) data (with regression line) for the same species [linear regression; $r^2 = 0.83$; $t(5) = 4.91$, $P < 0.01$]. Postcanine area data are from refs. 1 and 2. Mandibular cross-sectional data are from refs. 3 and 4, the authors, and the Middle Awash Research Project. All data used for linear regressions are in Table S2. We can only explore the relationship between morphology and carbon isotope composition using central tendency data, because the morphological and isotopic datasets could not be generated from the same specimens.

1. McHenry HM, Coffing K (2000) *Australopithecus* to *Homo*: Transformations in body and mind. *Annu Rev Anthropol* 29:125–146.
2. Suwa G, et al. (2009) Paleobiological implications of the *Ardipithecus ramidus* dentition. *Science* 326(5949):94–99.
3. Ward CV, Leakey MG, Walker A (2001) Morphology of *Australopithecus anamensis* from Kanapoi and Allia Bay, Kenya. *J Hum Evol* 41(4):255–368.
4. Wood BA (1991) *Koobi Fora Research Project: Hominid Cranial Remains* (Oxford Univ Press, New York).

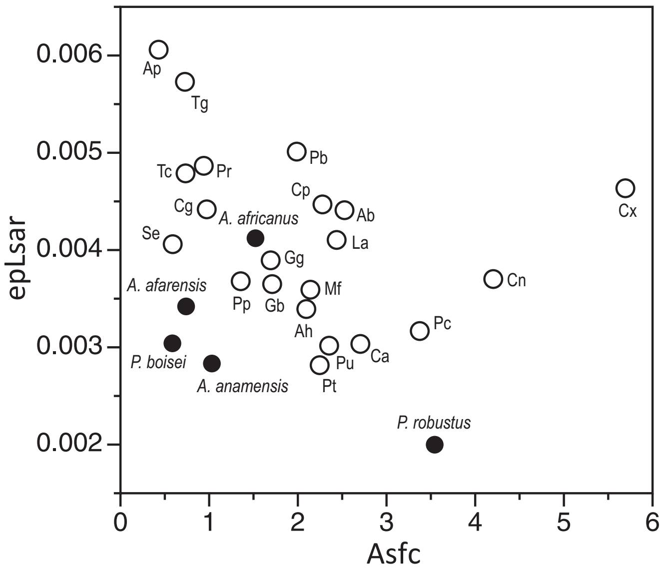

Fig. S5. Mean complexity (*Asfc*) and anisotropy (*epLsar*) values for fossil hominins (filled) and modern primates (open). Eastern African hominin and folivore microwear complexity values are similar, but their anisotropy (orientation) values are not. Consequently, multivariate cluster analysis groups these hominins closely together but not very distant from *A. africanus*, modern gorillas (*Gorilla* sp.), and generalist frugivores (data from refs. 1 and 2) (Fig. S6). *P. robustus* may have unique microwear textures among primates but clusters most closely to savanna baboons, hard-object specialists, and chimpanzees. Modern primates are labeled as follows: *Ateles belzebuth* (Ab), *Ateles hybridus* (Ah), *Alouatta palliata* (Ap), *Cercocebus atys* (Ca), *Colobus guereza* (Cg), *Cebus nigritus* (Cn), *Colobus polykomos* (Cp), *Cebus xanthosternos* (Cx), *Gorilla beringei* (Gb), *Gorilla gorilla* (Gg), *Lophocebus albigena* (La), *Macaca fascicularis* (Mf), *Procolobus badius* (Pb), *Papio cynocephalus* (Pc), *Pongo pygmaeus* (Pp), *Presbytis rubicunda* (Pr), *Pan troglodytes* (Pt), *Papio ursinus* (Pu), *Semnopithecus entellus* (Se), *Trachypithecus cristatus* (Tc), and *Theropithecus gelada* (Tg).

1. Grine FE, Sponheimer M, Ungar PS, Lee-Thorp J, Teaford MF (2012) Dental microwear and stable isotopes inform the paleoecology of extinct hominins. *Am J Phys Anthropol* 148(2): 285–317.
2. Scott RS, Teaford MF, Ungar PS (2012) Dental microwear texture and anthropoid diets. *Am J Phys Anthropol* 147:551–579.

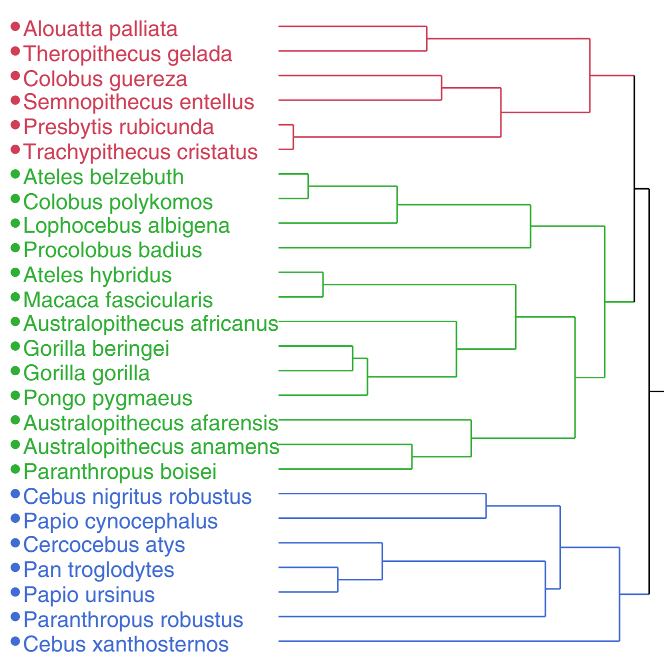

Fig. S6. Cluster analysis dendrogram (Ward's Method) based on modern and fossil primate *Asfc* and *epLsar* data. Modern folivores (red) and modern hard-object feeders/savanna generalists (blue) form distinct clusters. The only unexpected result among these groups is that *P. troglodytes* clusters with the hard-object/savanna generalist group. The fossil hominin *P. robustus*, a predicted hard-object feeder, clusters with the blue group as expected. A third deeply rooted cluster (green) is diverse and includes frugivores, folivores, *A. africanus*, and the tightly clustered eastern African australopiths. Data are from refs. 1 and 2.

1. Grine FE, Sponheimer M, Ungar PS, Lee-Thorp J, Teaford MF (2012) Dental microwear and stable isotopes inform the paleoecology of extinct hominins. *Am J Phys Anthropol* 148(2): 285–317.
2. Scott RS, Teaford MF, Ungar PS (2012) Dental microwear texture and anthropoid diets. *Am J Phys Anthropol* 147:551–579.

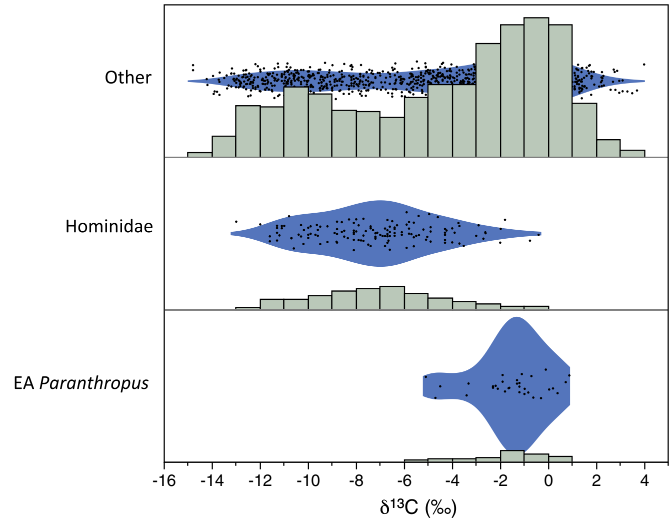

Fig. S7. (*Top*) Distribution of nonhominin $\delta^{13}C$ values from Ethiopia, Kenya, and South Africa spanning a time range of about 3 My (4.4 to ~1.3 Ma). (*Middle*) Distribution of hominin $\delta^{13}C$ values (excepting eastern African *Paranthropus*) from Ethiopia, Kenya, and South Africa for the same time period. (*Bottom*) Distribution of eastern African *Paranthropus* $\delta^{13}C$ values. The nonhominin $\delta^{13}C$ values are bimodal as expected for ecosystems dominated by browsing (C_3-consuming) and grazing (C_4-consuming) herbivores. Hominin $\delta^{13}C$ values (except eastern African *Paranthropus*) tend to fall in the trough that is lightly occupied by mixed C_3/C_4 consumers (e.g., some monkeys and carnivores), potentially telling us about hominin interactions with the plant and animal communities with which they coexisted. In contrast, there is much greater overlap in the carbon isotopic niche of *P. boisei* with numerically dominant C_4-consuming herbivores.

Table S1. Stable isotope composition data for all hominin specimens included in this study

Specimen	Taxon	$\delta^{13}C$	$\delta^{18}O$	Site/area	Source
ARA-VP-1 1818	*Ardipithecus ramidus*	−10.7	0.0	Aramis	1
ARA-VP-1 3290	*Ardipithecus ramidus*	−10.3	−0.9	Aramis	1
ARA-VP-1 3291	*Ardipithecus ramidus*	−11.2	−1.8	Aramis	1
ARA-VP-1 700	*Ardipithecus ramidus*	−8.5	1.8	Aramis	1
ARA-VP-6/1 500	*Ardipithecus ramidus*	−10.4	1.5	Aramis	1
A.L. 125–11	*Australopithecus afarensis*	−13.0	−8.4	Hadar	2
A.L. 207–17	*Australopithecus afarensis*	−4.3	−7.4	Hadar	2
A.L. 225–8	*Australopithecus afarensis*	−6.7	−2.4	Hadar	2
A.L. 249–27	*Australopithecus afarensis*	−10.0	−9.5	Hadar	2
A.L. 293–3	*Australopithecus afarensis*	−10.7	−9.0	Hadar	2
A.L. 309–8	*Australopithecus afarensis*	−6.4	−4.6	Hadar	2
A.L. 333–52	*Australopithecus afarensis*	−8.6	−7.1	Hadar	2
A.L. 411–1	*Australopithecus afarensis*	−7.7	0.5	Hadar	2
A.L. 423–1	*Australopithecus afarensis*	−7.2	−6.7	Hadar	2
A.L. 432–1	*Australopithecus afarensis*	−4.3	−8.0	Hadar	2
A.L. 437–2	*Australopithecus afarensis*	−6.6	−3.3	Hadar	2
A.L. 438–1h	*Australopithecus afarensis*	−10.2	−6.8	Hadar	2
A.L. 440–1	*Australopithecus afarensis*	−7.6	−7.3	Hadar	2
A.L. 444–2	*Australopithecus afarensis*	−8.0	−2.9	Hadar	2
A.L. 452–18	*Australopithecus afarensis*	−2.9	−2.7	Hadar	2
A.L. 462–7	*Australopithecus afarensis*	−6.4	−0.1	Hadar	2
A.L. 660–1	*Australopithecus afarensis*	−9.6	−1.1	Hadar	2
DIK 2–1	*Australopithecus afarensis*	−4.3	−7.8	Dikika	2
DIK 40–1	*Australopithecus afarensis*	−10.6	4.1	Dikika	2
DIK 49–12	*Australopithecus afarensis*	−4.9	5.7	Dikika	2
MLD 12	*Australopithecus africanus*	−7.7	−1.7	Makapansgat	3
MLD 28	*Australopithecus africanus*	−8.1	−3.5	Makapansgat	3
MLD 30	*Australopithecus africanus*	−5.6	−3.9	Makapansgat	3
MLD 41	*Australopithecus africanus*	−11.3	−3.9	Makapansgat	3
Sts 31	*Australopithecus africanus*	−6.8	−1.8	Sterkfontein	4
Sts 32	*Australopithecus africanus*	−7.8	−2.0	Sterkfontein	4
Sts 2218	*Australopithecus africanus*	−5.9	−3.6	Sterkfontein	4
Sts 2253*	*Australopithecus africanus*	−6.7		Sterkfontein	5
Sts 2518*	*Australopithecus africanus*	−10.0		Sterkfontein	5

Table S1. Cont.

Specimen	Taxon	$\delta^{13}C$	$\delta^{18}O$	Site/area	Source
Sts 45	*Australopithecus africanus*	−4.0	−3.1	Sterkfontein	4
Sts 72	*Australopithecus africanus*	−9.7	−2.7	Sterkfontein	4
StW 14un	*Australopithecus africanus*	−6.7	−2.6	Sterkfontein	6
StW 207	*Australopithecus africanus*	−2.0		Sterkfontein	6
StW 211	*Australopithecus africanus*	−7.3		Sterkfontein	6
StW 213i	*Australopithecus africanus*	−1.8		Sterkfontein	6
StW 229	*Australopithecus africanus*	−5.8		Sterkfontein	6
StW 236	*Australopithecus africanus*	−3.7		Sterkfontein	6
StW 252un	*Australopithecus africanus*	−7.4	−2.4	Sterkfontein	6
StW 276	*Australopithecus africanus*	−8.0		Sterkfontein	6
StW 303	*Australopithecus africanus*	−4.3		Sterkfontein	6
StW 304	*Australopithecus africanus*	−7.4		Sterkfontein	6
StW 309b (409)un	*Australopithecus africanus*	−6.1	−2.2	Sterkfontein	6
StW 315	*Australopithecus africanus*	−5.7		Sterkfontein	6
StW 529	*Australopithecus africanus*	−4.6	−3.8	Sterkfontein	Unpublished
StW 73	*Australopithecus africanus*	−8.8	−4.3	Sterkfontein	6
KNM-ER-18540	*Australopithecus anamensis*	−11.3	−0.6	Koobi Fora	7
KNM-ER-20420	*Australopithecus anamensis*	−10.8	−0.1	Koobi Fora	7
KNM-ER-30200 (B)	*Australopithecus anamensis*	−11.6	−0.1	Koobi Fora	7
KNM-ER-30745	*Australopithecus anamensis*	−10.0	1.3	Koobi Fora	7
KNM-KP-29287	*Australopithecus anamensis*	−10.2	0.0	Kanapoi	7
KNM-KP-30498 (D)	*Australopithecus anamensis*	−11.6	1.0	Kanapoi	7
KNM-KP-30502 (D & E)	*Australopithecus anamensis*	−9.5	−1.4	Kanapoi	7
KNM-KP-35839	*Australopithecus anamensis*	−11.3	0.3	Kanapoi	7
KNM-KP-35840 (A)	*Australopithecus anamensis*	−11.0	1.7	Kanapoi	7
KNM-KP-35842	*Australopithecus anamensis*	−10.3	—	Kanapoi	7
KNM-KP-35847	*Australopithecus anamensis*	−12.0	1.3	Kanapoi	7
KNM-KP-35851	*Australopithecus anamensis*	−11.3	1.1	Kanapoi	7
KT12 P3/H2*	*Australopithecus bahrelghazali*	−0.8		Chad	8
KT12/H1a*	*Australopithecus bahrelghazali*	−4.4		Chad	8
KT13-96-H1	*Australopithecus bahrelghazali*	−2.5		Chad	8
MH 1*	*Australopithecus sediba*	−11.7		Malapa	9
MH 2*	*Australopithecus sediba*	−11.6		Malapa	9
KNM-ER-1482 (A)	Hominidae indet.	−0.4	1.8	Koobi Fora	7
KNM-ER-2593	Hominidae indet.	−0.8	−0.4	Koobi Fora	7
KNM-ER-2607	Hominidae indet.	−9.2	2.6	Koobi Fora	7
KNM-ER-42705	Hominidae indet.	−2.0	−2.4	Koobi Fora	7
KNM-ER-5431 (F)	Hominidae indet.	−4.3	1.5	Koobi Fora	7
KNM-ER-1478 (A)	*Homo*	−8.4	0.7	Koobi Fora	7
KNM-ER-1483 (E)	*Homo*	−7.5	2.4	Koobi Fora	7
KNM-ER-1593 (C)	*Homo*	−7.4	2.1	Koobi Fora	7
KNM-ER-1802 (B)	*Homo*	−6.4	−1.2	Koobi Fora	7
KNM-ER-1805	*Homo*	−7.7	−2.4	Koobi Fora	7
KNM-ER-1814 (E)	*Homo*	−6.6	0.6	Koobi Fora	7
KNM-ER-2599	*Homo*	−9.9	−1.6	Koobi Fora	7
KNM-ER-2600	*Homo*	−6.1	−1.0	Koobi Fora	7
KNM-ER-3734	*Homo*	−5.8	1.2	Koobi Fora	7
KNM-ER-45501	*Homo*	−5.8	−0.7	Koobi Fora	7
KNM-ER-45502	*Homo*	−3.9	3.4	Koobi Fora	7
KNM-ER-45503	*Homo*	−8.6	1.7	Koobi Fora	7
KNM-ER-62000	*Homo*	−7.2	0.6	Koobi Fora	7
KNM-WT-37745	*Homo*	−6.4	−0.2	Nachukui	7
KNM-WT-42718	*Homo*	−7.2	−4.4	Nachukui	7
KNM-ER-7330	*Homo*	−5.5	2.3	Koobi Fora	7
OH 62	*Homo*	−8.3		Olduvai	10
OH 65	*Homo*	−5.2		Olduvai	10
OH 7	*Homo*	−8.8		Olduvai	10
SK 2635	*Homo*	−9.5	−3.5	Swartkrans	11
SK 27	*Homo*	−8.1	−2.3	Swartkrans	11
SK 847	*Homo*	−7.1	−0.4	Swartkrans	11
KNM-ER-1808 (I)	*Homo*	−2.6	−3.7	Koobi Fora	7
KNM-ER-730 (A)	*Homo*	−2.6	−0.7	Koobi Fora	7

Table S1. Cont.

Specimen	Taxon	$\delta^{13}C$	$\delta^{18}O$	Site/area	Source
KNM-ER-807	*Homo*	−5.4	−2.0	Koobi Fora	7
KNM-ER-808 (G)	*Homo*	−5.1	−2.2	Koobi Fora	7
KNM-ER-809 (A)	*Homo*	−5.0	−2.6	Koobi Fora	7
KNM-ER-820	*Homo*	−3.5	−0.2	Koobi Fora	7
KNM-ER-992 (B)	*Homo*	−5.0	0.6	Koobi Fora	7
KNM-ER-3733	*Homo*	−4.2	−2.8	Koobi Fora	7
KNM-LT-23181	*Kenyanthropus platyops*	−4.9	0.9	Nachukui	7
KNM-LT-23182	*Kenyanthropus platyops*	−5.9	0.5	Nachukui	7
KNM-LT-25936	*Kenyanthropus platyops*	−8.9	−1.7	Nachukui	7
KNM-WT-16006	*Kenyanthropus platyops*	−5.4	−3.3	Nachukui	7
KNM-WT-22936	*Kenyanthropus platyops*	−9.2	0.1	Nachukui	7
KNM-WT-38332	*Kenyanthropus platyops*	−2.7	−2.3	Nachukui	7
KNM-WT-38335	*Kenyanthropus platyops*	−5.6	−3.5	Nachukui	7
KNM-WT-38338	*Kenyanthropus platyops*	−9.9	−3.3	Nachukui	7
KNM-WT-38342	*Kenyanthropus platyops*	−11.1	−3.2	Nachukui	7
KNM-WT-38344	*Kenyanthropus platyops*	−3.7	−3.7	Nachukui	7
KNM-WT-38346	*Kenyanthropus platyops*	−8.8	0.8	Nachukui	7
KNM-WT-38350	*Kenyanthropus platyops*	−11.1	−1.2	Nachukui	7
KNM-WT-38356	*Kenyanthropus platyops*	−3.0	−2.5	Nachukui	7
KNM-WT-38358 (B, C, D, F)	*Kenyanthropus platyops*	−3.7	−1.1	Nachukui	7
KNM-WT-38359	*Kenyanthropus platyops*	−4.0	−0.4	Nachukui	7
KNM-WT-38361 (H)	*Kenyanthropus platyops*	−7.2	−1.7	Nachukui	7
KNM-WT-38362 (B)	*Kenyanthropus platyops*	−6.6	−2.3	Nachukui	7
KNM-WT-8556 (B)	*Kenyanthropus platyops*	−6.6	−3.3	Nachukui	7
KNM-WT-16005	*Paranthropus aethiopicus*	−5.1	−0.2	Nachukui	7
KNM-WT-17000	*Paranthropus aethiopicus*	−0.3	−2.7	Nachukui	7
KNM-WT-38351	*Paranthropus aethiopicus*	−4.7	3.8	Nachukui	7
KNM-WT-38353 (A & B)	*Paranthropus aethiopicus*	−4.5	−3.6	Nachukui	7
KNM-CH-302	*Paranthropus boisei*	−1.3		Baringo	12
KNM-ER-1171 (C)	*Paranthropus boisei*	−0.6	−1.9	Koobi Fora	12
KNM-ER-13750	*Paranthropus boisei*	0.2	0.5	Koobi Fora	12
KNM-ER-1469 (A)	*Paranthropus boisei*	−2.3	−0.1	Koobi Fora	12
KNM-ER-1479 (A)	*Paranthropus boisei*	−2.3	0.2	Turkana	12
KNM-ER-15940	*Paranthropus boisei*	−1.1	−0.6	Koobi Fora	12
KNM-ER-15951 (F)	*Paranthropus boisei*	−3.3	−0.9	Koobi Fora	7
KNM-ER-1804	*Paranthropus boisei*	−1.2	−0.7	Koobi Fora	12
KNM-ER-1806 (C)	*Paranthropus boisei*	−1.3	−2.0	Koobi Fora	12
KNM-ER-3737 (B)	*Paranthropus boisei*	−1.6	−2.5	Koobi Fora	12
KNM-ER-3887	*Paranthropus boisei*	−1.7	−2.9	Koobi Fora	12
KNM-ER-3952 (F)	*Paranthropus boisei*	−1.2	0.0	Koobi Fora	12
KNM-ER-6080	*Paranthropus boisei*	−2.2	−0.6	Koobi Fora	12
KNM-ER-729 (A)	*Paranthropus boisei*	0.0	−0.7	Koobi Fora	12
KNM-ER-732 (A)	*Paranthropus boisei*	−0.1	−1.8	Koobi Fora	12
KNM-ER-733 (A & D)	*Paranthropus boisei*	−1.0	−2.4	Koobi Fora	12
KNM-ER-802 (D & G)	*Paranthropus boisei*	−1.0	−0.9	Koobi Fora	12
KNM-ER-810	*Paranthropus boisei*	−3.4	−3.3	Koobi Fora	12
KNM-ER-816 (B)	*Paranthropus boisei*	−1.9	−1.3	Koobi Fora	12
KNM-ER-818	*Paranthropus boisei*	0.7	1.9	Koobi Fora	12
KNM-ER-1819	*Paranthropus boisei*	0.9	−0.7	Koobi Fora	7
KNM-ER-6082	*Paranthropus boisei*	−0.8	1.1	Koobi Fora	7
KNM-ER-801 (C)	*Paranthropus boisei*	0.4	−1.8	Koobi Fora	7
KNM-WT-17396	*Paranthropus boisei*	−1.9	−3.1	Nachukui	12
KNM-WT-37100	*Paranthropus boisei*	−1.8	−1.5	Nachukui	12
KNM-WT-37748	*Paranthropus boisei*	−2.1	0.0	Nachukui	12
OH 5	*Paranthropus boisei*	−1.2		Olduvai	10
Peninj	*Paranthropus boisei*	−0.7		Peninj	10
SK 14000	*Paranthropus robustus*	−5.9	−2.9	Swartkrans	4
SK 14132	*Paranthropus robustus*	−6.9	−0.2	Swartkrans	4
SK 1512	*Paranthropus robustus*	−8.8		Swartkrans	13
SK 19	*Paranthropus robustus*	−6.3	0.3	Swartkrans	4
SK 24605*	*Paranthropus robustus*	−6.8		Swartkrans	14
SK 24606*	*Paranthropus robustus*	−5.6		Swartkrans	14

Table S1. Cont.

Specimen	Taxon	$\delta^{13}C$	$\delta^{18}O$	Site/area	Source
SK 41	*Paranthropus robustus*	−6.7	0.7	Swartkrans	4
SK 5015	*Paranthropus robustus*	−9.6		Swartkrans	11
SK 57	*Paranthropus robustus*	−6.5	−0.3	Swartkrans	4
SK 876	*Paranthropus robustus*	−6.7	−4.0	Swartkrans	11
SK 878a	*Paranthropus robustus*	−6.8	−1.1	Swartkrans	11
SK 879†	*Paranthropus robustus*	−8.1		Swartkrans	13
SK 879†	*Paranthropus robustus*	−8.5		Swartkrans	13
SKW 3068	*Paranthropus robustus*	−8.1	−1.0	Swartkrans	4
SKW 4768	*Paranthropus robustus*	−7.4	0.1	Swartkrans	4
SKW 6	*Paranthropus robustus*	−7.0	−0.3	Swartkrans	4
SKW 6427†	*Paranthropus robustus*	−8.1		Swartkrans	14
SKX 1312	*Paranthropus robustus*	−8.1		Swartkrans	13
SKX 333	*Paranthropus robustus*	−10.0		Swartkrans	13
SKX 35025	*Paranthropus robustus*	−7.9		Swartkrans	13
SKX 5015	*Paranthropus robustus*	−9.6		Swartkrans	13
SKX 5939*	*Paranthropus robustus*	−4.9		Swartkrans	14
TM 1600	*Paranthropus robustus*	−7.9	−1.6	Kromdraai	4

In some cases, $\delta^{13}C$ values presented here may differ marginally (∼0.1–0.2‰) from those values in previous publications because of averaging of multiple analyses.

*Carbon isotope values generated using laser ablation. These values have been adjusted after 9 where relevant.

†Two SK 879 fragments might represent different individuals.

1. White TD, et al. (2009) Macrovertebrate paleontology and the Pliocene habitat of *Ardipithecus ramidus*. *Science* 326(5949):87–93.
2. Wynn JG, et al. (2013) Diet of *Australopithecus afarensis* from the Pliocene Hadar Formation, Ethiopia. *Proc Natl Acad Sci USA*, 10.1073/pnas.1222559110.
3. Sponheimer M, Lee-Thorp JA (1999) Isotopic evidence for the diet of an early hominid, *Australopithecus africanus*. *Science* 283(5400):368–370.
4. Sponheimer M, et al. (2005) Hominins, sedges, and termites: New carbon isotope data from the Sterkfontein valley and Kruger National Park. *J Hum Evol* 48(3):301–312.
5. Lee-Thorp JA, Sponheimer M, Passey BH, de Ruiter DJ, Cerling TE (2010) Stable isotopes in fossil hominin tooth enamel suggest a fundamental dietary shift in the Pliocene. *Philos Trans R Soc Lond B Biol Sci* 365(1556):3389–3396.
6. van der Merwe NJ, Thackeray JF, Lee-Thorp JA, Luyt J (2003) The carbon isotope ecology and diet of *Australopithecus africanus* at Sterkfontein, South Africa. *J Hum Evol* 44(5): 581–597.
7. Cerling TE, et al. (2013) Stable isotope-based diet reconstructions of Turkana Basin hominins. *Proc Natl Acad Sci USA*, 10.1073/pnas.1222568110.
8. Lee-Thorp J, et al. (2012) Isotopic evidence for an early shift to C_4 resources by Pliocene hominins in Chad. *Proc Natl Acad Sci USA* 109(50):20369–20372.
9. Henry AG, et al. (2012) The diet of *Australopithecus sediba*. *Nature* 487(7405):90–93.
10. van der Merwe NJ, Masao FT, Bamford MK (2008) Isotopic evidence for contrasting diets of early hominins *Homo habilis* and *Australopithecus boisei* of Tanzania. *S Afr J Sci* 104: 153–155.
11. Lee-Thorp JA, Thackeray JF, van der Merwe NJ (2000) The hunters and the hunted revisited. *J Hum Evol* 39(6):565–576.
12. Cerling TE, et al. (2011) Diet of *Paranthropus boisei* in the early Pleistocene of East Africa. *Proc Natl Acad Sci USA* 108(23):9337–9341.
13. Lee-Thorp JA, Van der Merwe NJ, Brain CK (1994) Diet of *Australopithecus robustus* at Swartkrans from stable carbon isotopic analysis. *J Hum Evol* 27:361–372.
14. Sponheimer M, Passey BH, de Ruiter DJ, Guatelli-Steinberg D, Cerling TE, Lee-Thorp JA (2006) Isotopic evidence for dietary variability in the early hominin *Paranthropus robustus*. *Science* 314:980–982.

Table S2. Summary data used in this paper for linear regression analysis

Taxon	Postcanine area	Mandibular CS area	Asfc	epLsar	$\delta^{13}C$
Ardipithecus ramidus	356	378			−10.4
Australopithecus anamensis	428	475	1.031	0.003	−11.2
Australopithecus afarensis	460	511	0.740	0.003	−7.4
Australopithecus africanus	516	547	1.522	0.004	−6.7
Paranthropus aethiopicus	688	657			−4.6
Paranthropus boisei	756	892	0.585	0.003	−1.2
Paranthropus robustus	588	672	3.543	0.002	−7.4

Postcanine data are from refs. 1 and 2. Mandibular cross-sectional area at M_1 data were generated from refs. 3 and 4, author data, and metrics provided by the Middle Awash Research Project. Mandibular data for very young specimens (e.g., Taung) were not included in the analysis. The median mandibular cross-sectional area data were, in some cases, generated from very few available specimens and should be viewed with caution. Sample sizes for mandibular area are as follows: *Ardipithecus ramidus* (1), *Australopithecus anamensis* (3), *Australopithecus afarensis* (23), *Australopithecus africanus* (9), *Paranthropus aethiopicus* (2), *Paranthropus boisei* (26), and *Paranthropus robustus* (8). Microwear data are from ref. 5. Median $\delta^{13}C$ values are generated from Table S1.

1. McHenry HM, Coffing K (2000) *Australopithecus* to *Homo*: Transformations in body and mind. *Annu Rev Anthropol* 29:125–146.
2. Suwa G, et al. (2009) Paleobiological implications of the *Ardipithecus ramidus* dentition. *Science* 326(5949):94–99.
3. Wood BA (1991) *Koobi Fora Research Project: Hominid Cranial Remains* (Oxford Univ Press, New York).
4. Ward CV, Leakey MG, Walker A (2001) Morphology of *Australopithecus anamensis* from Kanapoi and Allia Bay, Kenya. *J Hum Evol* 41(4):255–368.
5. Grine FE, Sponheimer M, Ungar PS, Lee-Thorp J, Teaford MF (2012) Dental microwear and stable isotopes inform the paleoecology of extinct hominins. *Am J Phys Anthropol* 148(2): 285–317.