Strategic and sporadic marine consumption at the onset of the Neolithic: increasing temporal resolution in the isotope evidence

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Stable isotope analysis has provided crucial new insights into dietary change at the Neolithic transition in north-west Europe, indicating an unexpectedly sudden and radical shift from marine to terrestrial resources in coastal and island locations. Investigations of early Neolithic skeletal material from Sumburgh on Shetland, at the far-flung margins of the Neolithic world, suggest that this general pattern may mask significant subtle detail. Analysis of juvenile dentine reveals the consumption of marine foods on an occasional basis. This suggests that marine foods may have been consumed as a crucial supplementary resource in times of famine, when the newly introduced cereal crops failed to cope with the demanding climate of Shetland. This isotopic evidence is consistent with the presence of marine food debris in contemporary middens. The occasional and contingent nature of marine food consumption underlines how, even on Shetland, the shift from marine to terrestrial diet was a key element in the Neolithic transition.

Keywords: Shetland, Mesolithic–Neolithic transition, marine consumption, stable isotopes, dentine, bone

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Modern cockle carbon isotope ratios

The values provided from the modern cockle flesh for consideration as part of the possible available dietary resource have not been adjusted for the fossil fuel effect (Suess effect) (Long *et al.* 2005; Pfister *et al.* 2011). Reduced atmospheric CO_2 $\delta^{13}C$ values, primarily due to fossil fuel combustion since industrialisation, will have affected the modern samples when compared to the archaeological material. It is to be expected that the values for prehistoric cockle flesh would be higher than the modern. An estimate for this shift might be 1–2‰, although it is not possible to be precise. Such an adjustment would have no substantive effect on the conclusions in this paper.

Table S1. Radiocarbon dates of Sumburgh humans.

Sample code	Lab number	^{14}C age (yr BP)	1σ error	Marine diet %	Calibrated ages (95.4%) and major probabilities
SUMB-45	SUERC-37437	4315	30	24	2930 (95.4%) 2660BC
SUMB-46	SUERC-37441	4415	30	30	3090 (95.4%) 2860BC
SUMB-43	SUERC-37435	4425	30	31	3090 (95.4%) 2860BC
SUMB-41	SUERC-37433	4435	30	3	3340 (25.3%) 3210BC; 3190 (5.0%) 3150BC; 3140 (65.1%) 2910BC
SUMB-8	SUERC-14984	4450	40	10	3340 (21.9%) 3210BC; 3200 (5.2%) 3150BC; 3140 (68.3%) 2900BC
SUMB-40	SUERC-37432	4460	30	26	3120 (92.6%) 2880BC
SUMB-42	SUERC-37434	4475	30	19	3330 (16.2%) 3210BC; 3190 (3.2%) 3150BC; 3130 (75.9%) 2900BC
SUMB-44	SUERC-37436	4475	30	21	3330 (13.3%) 3210BC; 3190 (2.4%) 3150BC; 3130 (79.6%) 2900BC
SUMB-13	SUERC-14986	4555	40	19	3360 (94.5%) 3010BC
SUMB-14	SUERC-14987	4555	40	24	3360 (93.5%) 3000BC
SUMB-7	SUERC-14980	4560	40	8	3370 (93.2%) 3080BC
SUMB-11	SUERC-14985	4615	40	40	3360 (95.4%) 2960BC

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Table S1. Continued.

Sample code	Lab number	^{14}C age (yr BP)	1σ error	Marine diet %	Calibrated ages (95.4%) and major probabilities
SUMB-24	SUERC-15178	4625	35	5	3510 (25.7%) 3420BC; 3390 (42.4%) 3260BC; 3250 (27.3%) 3100BC
SUMB-17	SUERC-14988	4630	40	16	3510 (15.7%) 3420BC; 3390 (79.7%) 3090BC

Notes to Table S1

Dating was undertaken at the Scottish Universities Environmental Research Centre (SUERC) in Glasgow, UK. All of the dated samples had δ^{13}C values higher than -21‰ (Table S3) and this was taken to be the terrestrial end member (0% marine diet) when calibrating the dates using an assumed marine component to the diet. Previous work has suggested that -20.9‰ is a suitable calibration value for the Neolithic diet in north-west Europe generally (Bonsall *et al.* 2009). The value for the marine end member used was -12.4‰ based on the average values for seal, seabird and cockle in equal proportions plus one trophic level. Percentage marine diet was estimated using a linear interpolation between the 100% terrestrial and 100% marine dietary end members. Linear equations were also derived using the heaviest and lightest end member values, giving an average deviation from the mean value of 11%. Therefore, the estimated percentage marine diet ±11% was used in the calibration. A ΔR value of 7±48 ^{14}C years was determined from recalculation of data in Ascough *et al.* (2007) to provide a weighted mean value ± standard error for predicted values. Using this ΔR value and the estimated percentage marine diets, the ^{14}C ages were calibrated using the OxCal 4.1 (Bronk Ramsey 2009) mixed curve (Marine09 [Reimer *et al.* 2009]).

Table S2. Teeth analysed, age at death and minimum number of individuals for each Sumburgh dentine sample.

Sample no.	Tooth	Root development	Minimum possible age at death (in years)	Estimated age at death (in years)
SUMB-39	LLE	apex closed	3–3.5	<9
SUMB-46	LRM1	Rt 3/4	6.5–7	6.5–7
SUMB-40	ULI1	complete	8.5–9.5	8.5–9.5
SUMB-4	ULM2	Rt 1/2	10.5–11.5	10.5–11.5
SUMB-5	URM2	Rt 3/4	11.5–12.5	11.5–12.5
SUMB-6	URM2	Rt 3/4	11.5–12.5	11.5–12.5
SUMB-11	LRM2	Rt 3/4	11.5–12.5	11.5–12.5
SUMB-43	LRM2	Rt 3/4	11.5–12.5	11.5–12.5
SUMB-2	ULM2	apex closed	14–15	17–25
SUMB-7	ULM2	apex closed	14–15	17–25
SUMB-16	ULM2	apex closed	14–15	17–25
SUMB-17	ULM2	apex closed	14–15	17–25
SUMB-8	URM2	apex closed	14–15	17–25
SUMB-24	URM2	apex closed	14–15	17–25
SUMB-41	URM1	apex closed	9–10	17–25
SUMB-45	LLM1	apex closed	9–10	17–25
SUMB-3	LLM2	apex closed	14–15	25–35
SUMB-12	LLM2	apex closed	14–15	25–35
SUMB-42	LLM2	apex closed	14–15	25–35
SUMB-44	LLM2	apex closed	14–15	25–35
SUMB-9	URM2	apex closed	14–15	25–35
SUMB-14	URM2	apex closed	14–15	25–35
SUMB-15	URM2	apex closed	14–15	25–35
SUMB-10	ULM2	apex closed	14–15	25–35
SUMB-13	ULM2	apex closed	14–15	25–35

Notes to Table S2

Tooth identification: the first letter (L or U) indicates upper (maxillary) or lower (mandibular); the second letter (L or R) indicates left or right; the third letter and associated number indicates the tooth (E = deciduous second molar; I1 = first incisor; M1 = first molar; M2 = second molar).

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The minimum possible age at death is based on tooth root development (AlQahtani *et al.* 2010) and the estimated age at death is based on tooth wear (Brothwell 1981; AlQahtani *et al.* 2010). The MNI (Minimum Number of Individuals), based on age and tooth type, totals 13. Based on the isotope analyses, it is likely that the majority of the samples are from separate individuals, although SUMB-5 and SUMB-11 may be from the same child.

Table S3. Carbon and nitrogen stable isotope data for the human bulk dentine and bone samples.

Sample no.	Age	Material	δ_{13}C(‰)	δ_{15}N(‰)	%C	%N	C:N
SUMB-2	adult	dentine	-19.0	12.2	40.6	15.0	3.3
SUMB-3	adult	dentine	-18.8	11.7	42.2	16.4	3.0
SUMB-4	juvenile	dentine	-19.3	11.9	42.3	15.2	3.2
SUMB-5	juvenile	dentine	-17.8	13.0	42.1	15.3	3.2
SUMB-6	juvenile	dentine	-18.5	12.6	42.2	14.8	3.3
SUMB-7	adult	dentine	-20.3	10.8	43.1	15.7	3.2
SUMB-8	adult	dentine	-20.1	10.6	41.5	14.8	3.3
SUMB-9	adult	dentine	-19.3	11.0	42.1	15.2	3.2
SUMB-10	adult	dentine	-19.3	11.6	42.7	15.1	3.3
SUMB-11	juvenile	dentine	-17.6	13.0	40.8	14.6	3.3
SUMB-12	adult	dentine	-19.8	11.5	42.1	15.2	3.2
SUMB-13	adult	dentine	-19.4	12.0	43.5	15.8	3.2
SUMB-14	adult	dentine	-18.8	10.6	41.9	15.3	3.2
SUMB-15	adult	dentine	-19.7	11.7	40.3	14.0	3.3
SUMB-16	adult	dentine	-18.8	12.1	41.5	15.0	3.2
SUMB-17	adult	dentine	-19.5	11.3	41.5	15.2	3.2
SUMB-24	adult	dentine	-20.6	10.7	44.1	17.5	2.9
SUMB-39c	juvenile	dentine	-20.3	11.2	42.0	15.2	3.2
SUMB-40c	juvenile	dentine	-18.9	11.5	42.0	15.3	3.2
SUMB-41c	adult	dentine	-20.6	10.9	42.0	15.3	3.2
SUMB-42c	adult	dentine	-19.4	12.0	42.1	15.3	3.2
SUMB-43c	juvenile	dentine	-18.5	12.1	42.0	15.9	3.1
SUMB-44c	adult	dentine	-19.7	11.6	42.4	15.3	3.1

Table S3. Continued.

Sample no.	Age	Material	$\delta_{13}C$(‰)	$\delta_{15}N$(‰)	%C	%N	C:N
SUMB-45c	adult	dentine	-19.0	11.7	42.0	15.3	3.2
SUMB-46c	juvenile	dentine	-18.7	11.9	42.1	15.4	3.2
SUMB-25	juvenile	bone: rib	-17.9	11.6	46.5	17.5	3.1
SUMB-26	adult	bone: pelvis	-19.8	10.6	46.6	15.8	3.5
SUMB-27	adult	bone: cranium	-20.1	11.0	34.6	12.1	3.4
SUMB-28	adult	bone: ulna	-20.7	10.8	39.8	14.0	3.3
SUMB-29	adult	bone: long bone fragment	-19.9	11.4	37.1	12.3	3.5
SUMB-30	adult	bone: patella	-20.3	10.6	38.5	13.1	3.4
SUMB-31	adult	bone: scapula	-20.0	10.2	35.7	12.5	3.3
SUMB-32	adult	bone: rib	-19.5	10.7	40.6	14.5	3.3
SUMB-33	adult	bone: ulna	-19.3	11.6	42.5	14.7	3.4
SUMB-34	adult	bone: rib	-20.2	10.6	36.9	12.6	3.4
SUMB-35	adult	bone: rib	-19.5	10.6	40.7	13.9	3.4
SUMB-36	adult	bone: ilium	-19.8	10.8	41.6	15.0	3.2

Notes to Table S3

Ages and tooth information are provided in detail in Table S1 for the dentine samples. Samples were measured in duplicate and the data averaged. SUMB-39 to SUMB-46 (marked c) are the eight samples for which incremental dentine analyses were undertaken and the data in this table are a combined mean for the increments (Table S5).

Table S4. Carbon and nitrogen stable isotope data for the animal samples.

The cow-sized ungulate, seal and shag (a type of cormorant) samples are all from the Late Mesolithic and Early Neolithic middens at West Voe. The cow samples are from the Sumburgh cist. The cockle muscle samples are all modern and were collected from Firths Voe, in the north of Mainland Shetland.

Sample no.	Species	Material	$\delta^{13}C$(‰)	$\delta^{15}N$(‰)	%C	%N	C:N
Sumb-19	cow	bone	-22.0	4.8	41.1	14.4	3.3
Sumb-22	cow	bone	-21.9	5.5	38.3	13.2	3.4
Wevo-1	ungulate	bone	-22.1	5.6	41.2	14.6	3.3
Wevo-2	ungulate	bone	-22.2	4.5	41.0	14.1	3.3
Wevo-3	seal	bone	-11.9	16.8	42.4	16.5	3.0
Wevo-4	seal	bone	-12.1	16.9	42.2	16.8	2.9
Wevo-5	seal	bone	-11.6	18.1	42.0	16.2	3.0
Wevo-6	seal	bone	-12.8	17.1	42.4	16.4	3.0
Wevo-7	seal	bone	-13.7	19.1	39.9	15.1	3.1
Wevo-8	seal	bone	-13.5	18.5	40.5	15.3	3.1
WV04 039a	bird: shag	bone	-12.5	16.7	42.8	16.7	3.3
WV04 057a	bird: shag	bone	-14.0	14.7	42.6	14.7	3.4
WV04 075a	bird: shag	bone	-12.6	13.7	43.0	14.7	3.4
WV04 076a	bird: shag	bone	-12.7	14.3	42.1	14.0	3.5
WV04 079a	bird: shag	bone	-12.9	13.9	42.4	14.3	3.5
SC1a	cockle	muscle	-17.0	8.1	44.7	12.9	4.2
SC2a	cockle	muscle	-16.8	8.1	45.7	13.9	3.8
SC3a	cockle	muscle	-16.9	8.0	46.1	14.2	3.8
SC4a	cockle	muscle	-17.4	7.7	45.9	7.7	3.9
SC5a	cockle	muscle	-17.9	8.0	44.7	8.0	4.8
SC6a	cockle	muscle	-17.0	7.9	45.5	13.9	3.8
SC7a	cockle	muscle	-16.8	7.3	44.0	12.3	4.2
SC8a	cockle	muscle	-16.7	8.8	44.7	8.8	4.1
SC9a	cockle	muscle	-17.3	8.0	46.6	8.0	4.0
SC10a	cockle	muscle	-17.7	7.5	45.1	7.5	4.4

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Table S5. Carbon and nitrogen stable isotope data for the incremental dentine samples.

The averages for each tooth are shown in bold and these are the data shown in Table S3. Each of the incremental samples was analysed in duplicate and averaged. The approximate age in years is based on the known incremental growth phases of the teeth analysed (Beaumont *et al.* 2013).

Sample no	$\delta^{13}C$(‰)	$\delta^{15}N$(‰)	%C	%N	C:N	Approximate age in years
SUMB 39 E 1	-20.9	10.9	45.9	16.4	3.3	-0.30
SUMB 39 E 2	-20.1	11.6	45.4	16.1	3.3	0.00
SUMB 39 E 3	-20.6	10.8	46.9	16.8	3.3	0.35
SUMB 39 E 4	-20.5	11.0	45.1	16.1	3.3	0.70
SUMB 39 E 5	-20.8	10.9	45.8	16.3	3.3	1.05
SUMB 39 E 6	-19.8	11.7	46.1	16.4	3.3	1.40
SUMB 39 E 7	-20.2	11.7	45.5	16.3	3.3	1.75
SUMB 39 E 8	-20.0	11.6	45.4	16.4	3.2	2.10
SUMB 39 E 9	-20.2	11.0	45.4	16.1	3.3	2.45
SUMB 39 E 10	-20.3	10.7	46.3	16.4	3.3	2.80
SUMB 39 E 11	-20.4	10.8	45.5	15.9	3.3	3.15
SUMB 39 E mean	-20.3	11.2	45.8	16.3	3.3	
SUMB 40 U1 1	-20.2	10.7	43.7	15.8	3.2	0.50
SUMB 40 U1 2	-19.7	10.8	45.5	16.4	3.2	0.93
SUMB 40 U1 3	-19.2	11.4	45.1	16.3	3.2	1.36
SUMB 40 U1 4	-18.9	11.8	45.4	16.4	3.2	1.79
SUMB 40 U1 5	-18.6	12.0	45.3	16.4	3.2	2.22
SUMB 40 U1 6	-18.5	12.1	41.8	15.1	3.2	2.65
SUMB 40 U1 7	-18.6	12.0	49.0	17.7	3.2	3.08
SUMB 40 U1 8	-18.4	12.2	45.0	16.3	3.2	3.51
SUMB 40 U1 9	-18.7	11.8	47.1	16.9	3.3	3.94
SUMB 40 U1 10	-19.0	11.8	45.0	16.3	3.2	4.37
SUMB 40 U1 11	-19.0	11.7	45.5	16.5	3.2	4.80
SUMB 40 U1 12	-19.0	11.5	46.0	16.7	3.2	5.23
SUMB 40 U1 13	-19.1	11.3	44.1	15.9	3.2	5.66
SUMB 40 U1 14	-19.0	11.4	44.1	16.0	3.2	6.09
SUMB 40 U1 15	-18.8	11.3	45.6	16.5	3.2	6.52
SUMB 40 U1 16	-19.0	11.4	44.7	16.1	3.2	6.95
SUMB 40 U1 17	-18.8	11.4	45.0	16.2	3.2	7.38

Table S5. Continued.

Sample no	$\delta^{13}C$(‰)	$\delta^{15}N$(‰)	%C	%N	C:N	Approximate age in years
SUMB 40 U1 18	-18.8	11.3	44.5	16.1	3.2	7.81
SUMB 40 U1 19	-18.8	11.3	45.5	16.4	3.2	8.24
SUMB 40 U1 20	-18.5	11.4	46.0	16.6	3.2	8.67
SUMB 40 U1 21	-18.2	11.7	44.7	16.0	3.3	9.10
SUMB 40 U1 mean	-18.9	11.5	45.2	16.3	3.2	
SUMB 41 M1 1	-21.1	11.1	40.5	14.6	3.2	0.93
SUMB 41 M1 2	-20.8	10.8	40.8	14.8	3.2	1.36
SUMB 41 M1 3	-20.6	10.9	42.3	15.4	3.2	1.79
SUMB 41 M1 4	-20.5	11.1	42.1	15.3	3.2	2.22
SUMB 41 M1 5	-20.6	11.0	41.1	14.9	3.2	2.65
SUMB 41 M1 6	-20.6	11.2	42.1	15.4	3.2	3.08
SUMB 41 M1 7	-20.5	11.1	41.6	15.1	3.2	3.51
SUMB 41 M1 8	-20.5	11.0	41.3	15.0	3.2	3.94
SUMB 41 M1 9	-20.4	10.8	41.7	15.2	3.2	4.37
SUMB 41 M1 10	-20.5	10.8	41.7	15.1	3.2	4.80
SUMB 41 M1 11	-20.4	10.7	41.8	15.1	3.2	5.23
SUMB 41 M1 12A	-20.5	10.5	41.5	15.0	3.2	5.66
SUMB 41 M1 13	-20.6	10.5	41.5	15.0	3.2	6.09
SUMB 41 M1 14	-20.6	10.7	41.9	15.1	3.2	6.52
SUMB 41 M1 15	-20.4	10.5	41.6	15.0	3.2	6.95
SUMB 41 M1 16	-20.5	10.7	42.6	15.4	3.2	7.38
SUMB 41 M1 17	-20.6	10.7	40.8	14.8	3.2	7.81
SUMB 41 M1 18	-20.5	11.0	41.0	14.7	3.3	8.24
SUMB 41 M1 19	-20.4	11.0	41.0	14.7	3.2	8.67
SUMB 41 M1 20	-20.5	11.1	40.7	14.5	3.3	9.10
SUMB 41 M1 21	-20.4	11.3	41.5	14.8	3.3	9.53
SUMB 41 M1 mean	-20.6	10.9	41.5	15.0	3.2	
SUMB 42 M2 1	-20.0	11.6	41.8	15.3	3.2	2.50
SUMB 42 M2 2	-19.8	11.4	42.2	15.6	3.2	3.30
SUMB 42 M2 3	-19.9	11.6	41.5	15.3	3.2	4.10
SUMB 42 M2 4	-19.6	11.6	41.5	15.2	3.2	4.90
SUMB 42 M2 5	-20.0	11.6	42.0	15.5	3.2	5.70
SUMB 42 M2 6	-19.9	11.8	42.4	15.6	3.2	6.50
SUMB 42 M2 7	-19.0	12.4	51.3	18.9	3.2	7.30
SUMB 42 M2 8	-18.7	12.6	41.4	15.2	3.2	8.10

Table S5. Continued.

Sample no	$\delta^{13}C$(‰)	$\delta^{15}N$(‰)	%C	%N	C:N	Approximate age in years
SUMB 42 M2 9	-18.5	12.9	41.1	15.0	3.2	8.90
SUMB 42 M2 10	-17.8	13.3	41.5	15.1	3.2	9.70
SUMB 42 M2 11	-19.4	11.9	42.5	15.5	3.2	10.50
SUMB 42 M2 12	-20.1	11.8	41.1	15.0	3.2	11.30
SUMB 42 M2 13	-19.5	11.7	41.8	15.3	3.2	12.10
SUMB 42 M2 14	-19.7	11.8	43.2	15.8	3.2	12.90
SUMB 42 M2 15	-19.6	12.0	40.8	14.9	3.2	13.70
SUMB 42 M2 16	-19.1	12.1	42.0	15.4	3.2	14.50
SUMB 42 M2 17	-19.2	12.1	40.2	14.6	3.2	15.30
SUMB 42 M2 mean	-19.4	12.0	42.3	15.5	3.2	
SUMB 43 M2 1	-19.2	12.2	41.1	15.2	3.1	2.50
SUMB 43 M2 2	-18.5	12.5	41.4	15.7	3.1	3.02
SUMB 43 M2 3	-19.0	11.6	43.8	16.7	3.1	3.54
SUMB 43 M2 4	-19.2	11.6	35.5	13.4	3.1	4.06
SUMB 43 M2 5	-19.0	11.8	43.8	16.6	3.1	4.58
SUMB 43 M2 6	-18.9	11.5	42.3	16.1	3.1	5.10
SUMB 43 M2 7	-18.9	11.2	41.8	15.8	3.1	5.62
SUMB 43 M2 8	-18.6	11.3	42.1	15.9	3.1	6.14
SUMB 43 M2 9	-18.1	11.8	42.1	16.0	3.1	6.66
SUMB 43 M2 10	-17.7	12.4	43.2	16.3	3.1	7.18
SUMB 43 M2 11	-17.8	12.6	40.7	15.3	3.1	7.70
SUMB 43 M2 13	-18.0	13.0	42.4	16.0	3.1	8.74
SUMB 43 M2 14	-18.1	12.9	43.4	16.3	3.1	9.26
SUMB 43 M2 mean	-18.5	12.1	42.0	15.9	3.1	
SUMB 44 M2 1	-20.1	11.8	40.8	15.2	3.1	2.50
SUMB 44 M2 2	-19.4	12.1	43.3	16.2	3.1	3.37
SUMB 44 M2 3	-18.8	11.8	43.5	16.2	3.1	4.24
SUMB 44 M2 4	-18.8	11.4	42.4	16.0	3.1	5.11
SUMB 44 M2 5	-19.5	10.7	42.8	16.2	3.1	5.98
SUMB 44 M2 6	-19.9	11.2	42.0	15.8	3.1	6.85
SUMB 44 M2 7	-19.8	11.2	42.1	15.7	3.1	7.72
SUMB 44 M2 8	-19.9	11.0	42.2	15.8	3.1	8.59
SUMB 44 M2 9	-20.0	11.9	43.4	16.0	3.2	9.46
SUMB 44 M2 10	-19.9	11.8	41.8	15.6	3.1	10.33
SUMB 44 M2 11	-19.7	11.9	42.8	15.8	3.2	11.20

Table S5. Continued.

Sample no	$\delta^{13}C$(‰)	$\delta^{15}N$(‰)	%C	%N	C:N	Approximate age in years
SUMB 44 M2 12	-20.0	11.7	42.2	15.7	3.1	12.07
SUMB 44 M2 13	-20.1	11.8	43.5	16.0	3.1	12.94
SUMB 44 M2 14	-20.1	11.9	39.6	14.3	3.2	13.81
SUMB 44 M2 15	-19.9	12.2	42.4	15.3	3.2	14.68
SUMB 44 M2 mean	-19.7	11.6	42.3	15.7	3.1	
SUMB 45 M1 1	-20.2	10.4	39.7	14.4	3.2	0.50
SUMB 45 M1 2	-19.4	11.0	40.2	14.5	3.2	1.10
SUMB 45 M1 3	-19.0	11.6	42.7	15.4	3.2	1.70
SUMB 45 M1 4	-18.8	11.9	40.8	14.7	3.2	2.30
SUMB 45 M1 5	-18.5	12.1	41.2	15.0	3.2	2.90
SUMB 45 M1 6	-18.8	11.9	45.7	16.6	3.2	3.50
SUMB 45 M1 7	-18.6	12.1	36.3	13.1	3.2	4.10
SUMB 45 M1 8	-19.0	11.8	41.0	14.7	3.3	4.70
SUMB 45 M1 9	-19.1	11.8	41.9	15.0	3.3	5.30
SUMB 45 M1 10	-19.0	11.7	45.3	16.2	3.3	5.90
SUMB 45 M1 11	-18.9	11.9	40.0	14.4	3.2	6.50
SUMB 45 M1 12	-19.2	11.8	40.0	14.2	3.3	7.10
SUMB 45 M1 13	-19.2	11.6	40.4	14.4	3.3	7.70
SUMB 45 M1 14	-19.2	11.8	41.6	14.6	3.3	8.30
SUMB 45 M1 15	-18.7	12.0	28.9	9.9	3.4	8.90
SUMB 45 M1 mean	-19.0	11.7	40.4	14.5	3.3	
SUMB46 M1 1	-19.0	12.2	40.8	14.7	3.2	0.50
SUMB46 M1 2	-18.5	12.3	39.2	14.3	3.2	0.92
SUMB46 M1 3	-18.9	11.8	38.3	14.0	3.2	1.34
SUMB 46 M1 4	-19.1	11.6	38.9	14.0	3.2	1.76
SUMB46 M1 5	-19.2	11.6	39.5	14.3	3.2	2.18
SUMB46 M1 6	-19.2	11.4	42.3	15.1	3.3	2.60
SUMB46 M1 7	-18.9	11.2	39.4	13.8	3.3	3.02
SUMB 46 M1 8	-18.8	11.3	39.4	13.9	3.3	3.44
SUMB 46 M1 9	-18.6	11.5	40.7	14.3	3.3	3.86
SUMB 46 M1 10	-18.4	11.7	39.0	13.5	3.4	4.28
SUMB 46 M1 11	-18.2	12.2	39.4	13.9	3.3	4.70
SUMB 46 M1 12	-17.9	12.8	40.6	14.2	3.3	5.12
SUMB 46 M1 13	-18.5	12.9	40.8	14.0	3.4	5.54
SUMB 46 M1 mean	-18.7	11.9	39.9	14.1	3.3	

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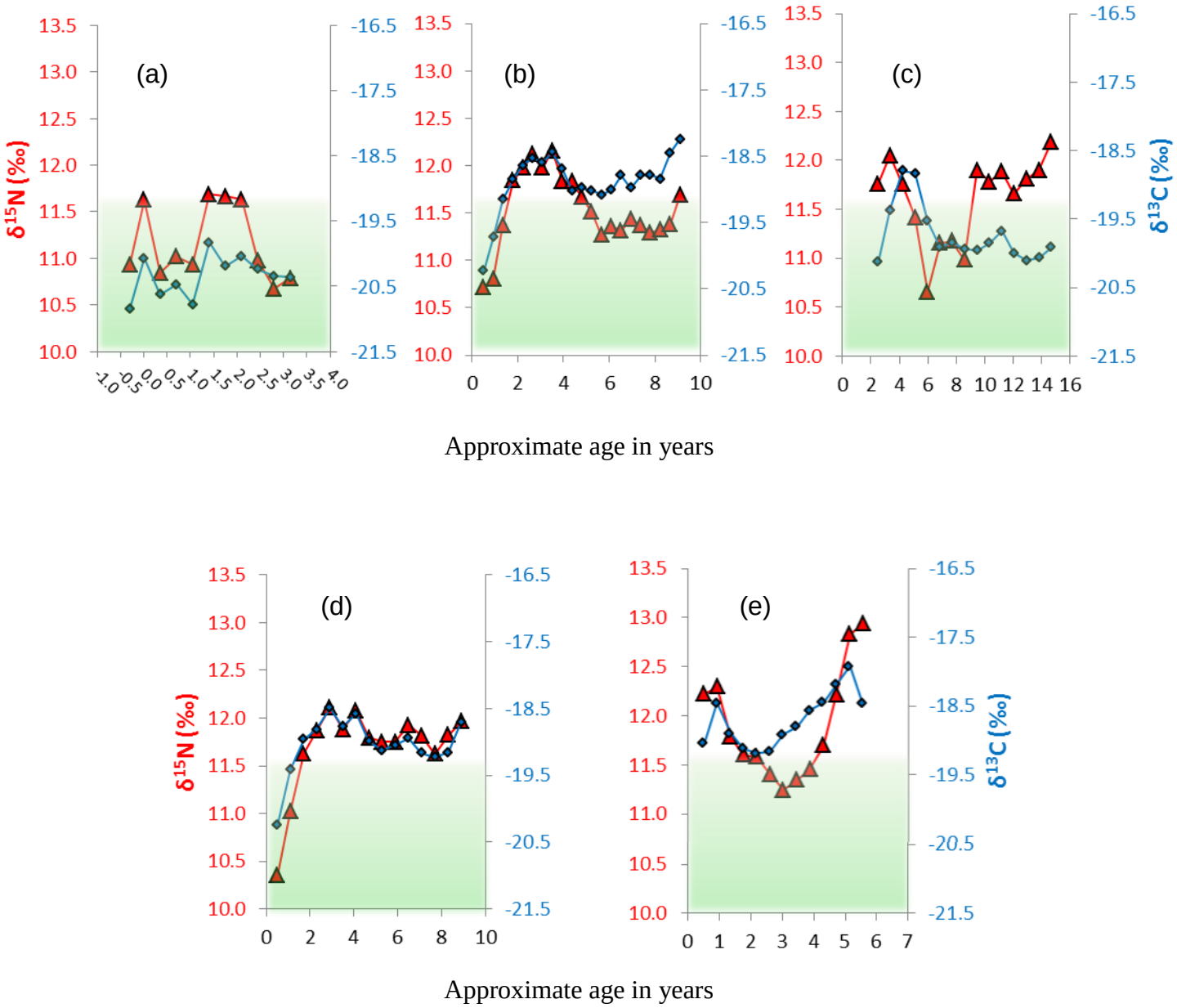

Figure S1. Carbon and nitrogen stable isotope ratios of the incremental dentine samples from a) SUMB-39; b) SUMB-40; c) SUMB-44; d) SUMB-45; and e) SUMB-46. The shaded green area at the bottom of each chart represents a purely terrestrial diet, based on the conservative limit of -19.1‰.

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