Data Repository 1. Phytolith morphotype descriptions and corresponding compound variables and vegetation categories used (for definitions, see Strömberg, 2003). FI = forest indicator; GSSC = grass silica short cell. FIs and GSSCs were used for vegetation reconstruction.

Morphotype	Description	Compound variable	Vegetation Category
M-7	Vertebral column body	GRASS-D	Potential grass
M-8	Solid parenchyma cell	OTH	Other
Epi-1	Polyhedral epidermis	DICOT-GEN	FI
Epi-6	Epidermal plate of sedges	SEDGE	Sedge
Epi-8	Wavy elongate	CONI/MONO	Potential grass
EpiF-1	Epidermal amoeba body	DICOT-GEN	FI
Tra-1	Hollow and infilled helix	FI-GEN	FI
Tra-2	Worm/pupa like infilled helical tracheary element	FI-GEN	FI
Tra-8	*Podocarpus* type tracheary element	CONI	FI
Tri-8	Trichome filling	GRASS/MONO-ND	Potential grass
Cy-1	Verrucate and mushroom shaped cystolith	DICOT-GEN	FI
Clm-1	*Nypa*-type body: bowler hat with tubercles	PALM - D	FI, Palm
Clm-2a	Echinate (spiky) sphere	PALM-D	FI, Palm
Clm-4	*Costus*-type body	MAR/COST	FI, *Costus*-type body
Cl-4	Small, smooth, pink sphere	FI-GEN	FI
Cl-5	Compound sphere	FI-GEN	FI
Cl-6	Tubercle covered compound sphere/irregular body	PALM-D	FI, Palm
Cl-7	Small rugulose sphere and subsphere	FI-GEN	FI
Cl-8	Large nodular body	DICOT-WO?	FI
Cl-9	Pilosate rugose body	FI-GEN	FI
Cl-10	MD clump	FI-GEN	FI
Vl-3	Sedgelike Vl plate	DICOT-GEN	FI
ClF-2	Smooth pink sphere or subsphere, like large Cl-4 or Clm-2 w/out spikes	FI-GEN?	FI
Elo-1	Smooth elongate	OTH	Other
Elo-2	Thick trapezoidal smooth elongate	OTH	Other
Elo-3	Faceted elongate	CONI/MONO	Potential grass
Elo-7	Smooth cylindrical elongate	OTH	Other
Elo-18	MD-elongate	DICOT-WO	FI
EloF-1	Thick squarish rod, softly faceted	OTH	Other
EloF-2	Smooth elongate w/ faceted edge	OTH	Other
EloF-3	Smooth elongate w/ faceted edge	OTH	Other
Scl-3	Mutifaceted S-body	DICOT-WO?	FI
Scl-4	Spongy mesophyll body	FI-GEN	FI
SclF-3	Large rounded, irregular body with large irregular blunt knobs	NOGRA-PLANT	FI

Data repository 1, continued.

Morphotype	Description	Compound variable	Vegetation Category
Blo-1	Rectangular plate	GRASS/MONO-ND	Potential grass
Blo-2	Thickened rectangular plate	OTH	Other
Blo-3	Faceted rectangular plate	CONI	FI
Blo-4	Thick polyhedral plate	PALM-ND	FI, Palm
Blo-5	Chamerops blocky polyhedron	PALM-ND	FI, Palm
Blo-6	3D blocky polyhedron	FI-GEN	FI
Blo-10	Bulliform B: keystone shaped plate	GRASS-D	Potential grass
Blo-12	Irregular, faceted GM body	OTH	Other
KN-7	Rounded clump with blunt knob	GRASS-D	Potential grass
KN-8	Subspherical clump w/ branched processes	GRASS/MONO-ND	Potential grass
CO-1 A	Generic (truncated) conical rondel type A	POOID-ND	GSSC
CO-1 B	Generic (truncated) conical rondel type B	POOID-ND	GSSC
CO-2	Truly conical rondel	POOID-D	GSSC
COF-1B	Tall rondel with spiked top	BAMB/B	GSSC
KR-1	Regular keeled rondel	POOID-ND	GSSC
KR-2	Curved keeled rondel	POOID-ND	GSSC
Py-1	Regular pyramidal	POOID-ND	GSSC
SA-1	True saddle	CHLOR	GSSC
Bl-1	Regular S*tipa* type bilobate	POOID-D	GSSC

Data Repository 2. Definition of compound variables used in phytolith analysis (Strömberg, 2003).

Morphotype group	Plant type group (Compound variable)	Plant type inferred
Non-GSSC	DICOT-WO	Woody dicotyledon
	DICOT-GEN	General (woody or herbaceous) dicotyledon
	FI-GEN	General forest indicator (dicotyledon; conifer/gymnosperms, Marantaceae, fern, to some degree palm, *Selaginella*)
	CONI	Conifer
	CONI-MONO	Conifer/monocotyledon
	EQUI	*Equisetum*
	PALM-D	Diagnostic palm; forms exclusive to palms
	PALM-ND	Nondiagnostic palm; forms so far found primarily in palms, but likely not exclusive to palms
	MAR/COST	Marantaceae/Costaceae; Zingiberales
	SEDGE	Sedge
	GRASS/MONO-ND	Grass/monocotyledon; forms abundantly but not exclusively produced in grasses and some other monocotyledons
	GRASS-D	Diagnostic non-GSSC grass; forms exclusively produced in grasses but not used in vegetation analysis
	OTH	Other non-grass plants; nondiagnostic or unknown
	NONGRA-PLANT	Modern plants but shows resemblance to other non-grass (FI) morphotypes
	AQ-MONO	Aquatic monocotyledon; fossil morphotype not yet found in modern plants but shows resemblance to cell types found in some modern aquatic monocotyledons
GSSC	BAMB/B	"Bambusoid"/basal grasses
	POOID-D	Diagnostic pooid; forms that are highly diagnostic of pooids
	POOID-ND	Nondiagnostic pooid; forms abundantly but not exclusively produced in pooid grasses
	CHLOR	Diagnostic chloridoid; forms that are highly diagnostic of chloridoids
	PANI	Diagnostic panicoid; formst that are highly diagnostic of panicoids
	PACMAD-GEN	General PACMAD (C3 or C4)
	OTHG	Other GSSC; nondiagnostic or unknown GSSC

Data Repository 3a. Soil characteristics and biosilica morphotypes for samples from the Middle Eocene Timberhills A locality, Montana. *VG=very good; G=acceptable-good; P=poor; VP=very poor; VP samples were excluded from quantitative analysis. **p = present but not part of count.

Sample number	Meter level	Soil type	Soil horizon	Munsell colors	Phytolith abundance	Preser-vation*	Phytolith morphotype (compound variable)**			
							M-7 (GRASS-D)	M-8 (OTH)	Epi-1 (DICOT-GEN)	Epi-6 (SEDGE)
THA09-03	0.31	Inceptisol	B	2.5 YR 8/2.5	medium	G	0	0	0	7
THA09-05	1.41	Inceptisol	A	5 YR 8/1	medium	VP	--	p	p	--
THA09-10	3.9	Composite		2.5 YR 7/2	medium	G-P	0	0	0	8
THA09-12	6	Inceptisol	B	5 YR 7/2	medium	G	0	2	1	1
THA09-14	7.29	Inceptisol	A	5 YR 8/2	medium	G	0	0	0	3
THA09-15	8.18	Composite		5 YR 7.5/2	medium	G	0	1	2	1
THA09-17	9.25	Composite		5 YR 8/2	medium	VG	0	0	0	1
THA09-18	9.7	Composite		2.5 YR 6/2	high	VG	0	0	0	0
THA09-21	10.3	Composite		2.5 YR 8/2	med-high	G-P	0	0	0	3
THA09-25	11.17	Composite		2.5 YR 7/6	medium	G-P	0	2	2	1
THA09-30	14.1	Alfisol	A	5 YR 7/2	med-high	VP	--	--	--	p
THA09-32	15.03	Alfisol	A	2.5 YR 8/3	high	VG	1	0	0	1
THA09-34	16.86	Alfisol	B	5 YR 8/1	high	VG	0	0	0	2
THA09-35	17.6	Alfisol	A	5 YR 8/1	high	G-P	0	0	0	5
THA09-37	18.25	Alfisol	C	5 YR 8/1	high	G-VG	0	0	0	p
THA09-40	19.91	Alfisol	A	5 YR 7/2	low-medium	VP	--	--	--	p
THA09-44	22.99	Alfisol	B	5 YR 8/2	high	VG	0	0	0	1
THA09-45	23.3	Alfisol	A	2.5 YR 8/2	high	G	0	0	0	2
THA09-46	24.65	Entisol	A	5 YR 8/1	med-high	G	0	0	0	1
THA09-50	27.74	Inceptisol	A	5 YR 8/1	med-high	G	1	0	0	3
THA09-52	29.38	Alfisol	B	5 YR 7.5/1	low-medium	G	0	2	0	6
THA09-55	30.89	Alfisol	A	5 YR 7.5/1	medium	G	0	6	1	0
THA09-57	33.19	Inceptisol	A	5 YR 7/3	high	G	0	0	0	1
THA09-59	34.34	Composite		5 YR 7/2	medium	G-P	0	5	0	1
THA09-65	38.9	Inceptisol	A	5 YR 8/1.5	med-high	G	0	0	0	0
THA09-68	40.58	Inceptisol	A	5 YR 8/1	med-high	G	0	0	0	5
THA09-69	43.54	Entisol	A	5 YR 8/1	med-high	G-P	0	6	0	2

Data Repository 3a, continued.

Sample number	Phytolith morphotype (compound variable)**											
	Epi-8 (CONI/ MONO)	EpiF-1 (DICOT-GEN)	Tra-1 (FI-GEN)	Tra-2 (FI-GEN)	Tra-8 (CONI)	Tri-8 (GRASS/MONO-ND)	Cy-1 (DICOT-GEN)	Clm-1 (PALM-D)	Clm-2a (PALM-D)	Clm-4 (MAR/ COST)	Cl-4 (FI-GEN)	Cl-5 (FI-GEN)
THA09-03	0	0	0	0	0	8	0	0	4	0	11	4
THA09-05	--	--	--	--	--	p	--	--	p	--	p	p
THA09-10	0	0	0	0	0	20	0	0	3	0	22	8
THA09-12	0	1	0	0	0	38	0	0	8	0	26	15
THA09-14	0	6	1	0	0	19	0	0	6	10	5	5
THA09-15	0	1	1	1	0	33	0	0	6	1	32	15
THA09-17	0	8	0	0	0	7	0	0	2	83	2	4
THA09-18	0	4	0	0	0	1	0	0	5	125	1	7
THA09-21	0	0	0	0	0	19	0	1	6	62	2	13
THA09-25	0	2	0	0	0	38	1	0	1	0	48	9
THA09-30	--	p	--	--	--	p	--	--	p	--	p	p
THA09-32	0	0	1	0	0	0	0	0	1	155	2	2
THA09-34	0	0	0	0	0	13	0	0	0	0	3	0
THA09-35	0	7	0	0	0	10	0	0	8	0	8	15
THA09-37	3	0	0	0	0	15	0	0	1	0	10	3
THA09-40	--	--	--	--	--	p	--	--	p	p	p	p
THA09-44	0	3	0	1	0	15	0	0	0	186	0	2
THA09-45	0	0	0	1	0	3	0	0	p	16	0	2
THA09-46	0	0	0	0	0	6	0	0	1	71	2	3
THA09-50	0	0	0	0	0	18	0	0	3	3	2	3
THA09-52	1	2	2	0	0	60	0	0	4	0	9	2
THA09-55	0	2	1	0	0	15	0	0	2	1	39	18
THA09-57	0	0	0	1	0	3	0	1	2	158	0	0
THA09-59	0	0	0	0	0	16	0	0	1	0	2	0
THA09-65	0	2	1	0	0	10	0	0	0	156	1	2
THA09-68	0	1	2	0	0	5	0	0	0	160	3	3
THA09-69	0	1	0	0	0	10	0	0	4	8	14	24

Data Repository 3a, continued.

Sample number	Phytolith morphotype (compound variable)**													
	Cl-6 (PALM -D)	Cl-7 (FI-GEN)	Cl-8 (DICOT -WO?)	Cl-9 (FI-GEN)	Cl-10 (FI-GEN)	VI-3 (DICOT -GEN)	ClF-2 (FI-GEN?)	Elo-1 (OTH)	Elo-2 (OTH)	Elo-3 (CONI/ MONO)	Elo-7 (OTH)	Elo-18 (DICOT-WO)	EloF-1 (OTH)	EloF-2 (OTH)
THA09-03	1	2	0	5	101	0	7	3	0	0	11	6	1	0
THA09-05	--	p	--	p	p	--	p	p	--	--	p	--	--	--
THA09-10	1	6	0	3	77	0	0	0	0	0	4	5	0	0
THA09-12	0	1	0	3	48	0	19	1	1	0	4	8	0	1
THA09-14	0	0	0	11	77	0	19	5	0	0	20	3	0	2
THA09-15	0	2	0	1	43	0	18	0	0	0	3	1	2	0
THA09-17	0	0	0	1	28	0	5	45	0	1	0	8	0	0
THA09-18	0	0	4	0	2	0	0	18	0	0	4	4	1	0
THA09-21	1	2	0	6	93	0	11	5	0	0	10	2	0	0
THA09-25	0	0	1	1	75	1	10	0	0	1	5	1	0	0
THA09-30	--	--	--	p	p	--	p	p	--	--	p	p	p	--
THA09-32	0	0	2	1	2	0	0	7	0	0	1	0	1	0
THA09-34	0	0	0	0	0	0	0	4	2	0	63	12	3	0
THA09-35	0	0	2	2	34	0	8	8	0	0	11	14	1	0
THA09-37	0	0	0	0	1	0	0	0	0	1	44	6	0	0
THA09-40	--	p	--	p	p	--	p	--	--	--	--	p	--	--
THA09-44	0	0	0	0	4	0	0	1	0	2	20	5	0	0
THA09-45	0	0	1	0	182	0	3	5	0	0	10	6	0	0
THA09-46	0	0	0	1	43	0	6	7	0	17	16	17	1	0
THA09-50	0	0	0	0	22	0	4	5	0	0	9	21	2	0
THA09-52	0	0	0	0	70	0	13	5	0	0	19	4	1	2
THA09-55	0	2	0	1	66	0	0	1	0	0	4	4	0	0
THA09-57	0	0	0	0	26	0	0	2	1	0	8	8	0	1
THA09-59	0	0	0	4	130	0	14	3	0	0	9	2	0	0
THA09-65	0	0	0	0	12	0	6	0	1	2	2	2	1	0
THA09-68	0	0	0	0	17	0	7	1	0	0	0	2	0	0
THA09-69	0	0	0	1	132	0	25	1	0	0	2	4	0	0

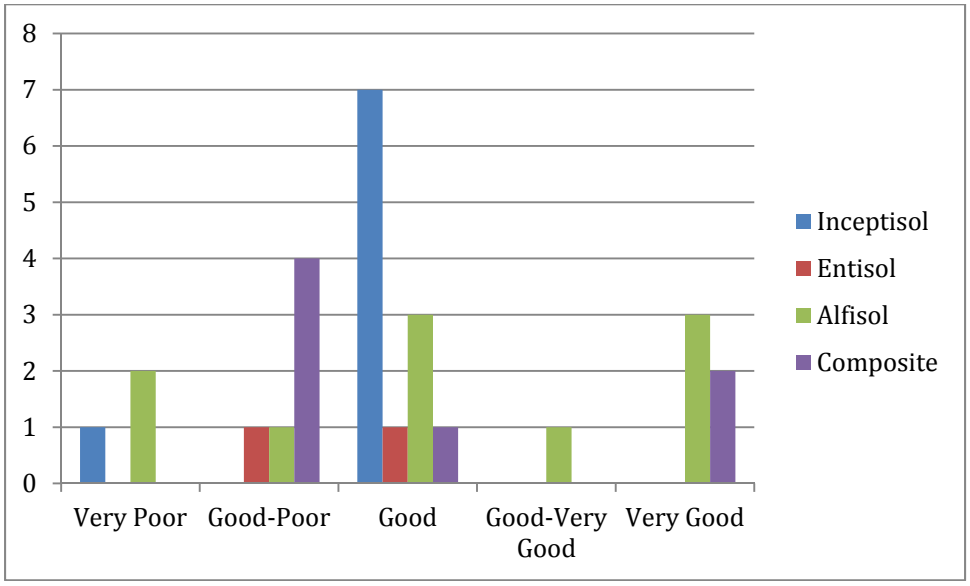
Data Repository 3a, continued.

Sample number	Phytolith morphotype (compound variable)**														
	EloF-3 (OTH)	Scl-3 (DICOT-WO?)	Scl-4 (FI-GEN)	SclF-3 (NOGRA-PLANT)	Blo-1 (GRASS/MONO-ND)	Blo-2 (OTH)	Blo-3 (CONI)	Blo-4 (PALM-ND)	Blo-5 (PALM-ND)	Blo-6 (FI-GEN)	Blo-10 (GRASS-D)	Blo-12 (OTH)	KN-7 (GRASS-D)	KN-8 (GRASS/MONO-ND)	CO-1A (POOID-ND)
THA09-03	0	0	0	0	1	0	1	0	2	0	0	0	0	0	57
THA09-05	--	--	--	--	p	--	--	p	p	p	--	--	p	p	p
THA09-10	0	0	0	0	1	1	1	0	1	1	0	0	0	0	29
THA09-12	0	0	0	2	4	6	0	5	0	4	0	0	0	0	29
THA09-14	0	0	0	0	13	2	0	0	1	3	0	0	0	0	72
THA09-15	0	0	0	0	12	0	0	2	0	2	0	0	0	0	38
THA09-17	2	2	0	0	5	1	2	0	0	0	0	0	0	0	36
THA09-18	0	0	0	0	2	0	2	0	0	0	0	0	0	0	20
THA09-21	2	0	0	3	1	2	2	1	0	1	0	0	0	0	13
THA09-25	1	0	0	0	6	1	0	3	0	3	1	0	0	0	16
THA09-30	--	--	--	p	p	--	--	p	--	--	--	p	--	--	p
THA09-32	0	0	0	0	0	1	0	0	0	0	0	0	0	0	4
THA09-34	0	0	0	0	0	0	2	0	0	0	0	0	0	0	109
THA09-35	1	0	0	0	2	1	0	0	0	0	0	0	0	0	115
THA09-37	1	0	0	0	0	0	3	0	0	0	1	0	0	0	141
THA09-40	--	--	--	--	p	p	--	p	p	p	p	--	--	--	p
THA09-44	0	0	0	0	0	0	2	1	0	1	0	0	0	0	20
THA09-45	0	0	0	0	2	1	0	0	0	0	0	0	0	0	29
THA09-46	0	0	0	0	8	4	0	0	1	2	0	0	0	0	60
THA09-50	0	0	0	0	9	4	0	0	2	0	1	0	0	0	113
THA09-52	1	0	0	0	6	1	0	1	0	4	1	0	0	0	20
THA09-55	0	0	0	0	2	2	0	0	0	2	0	0	0	0	51
THA09-57	0	0	0	0	0	0	2	0	0	1	0	0	0	0	14
THA09-59	0	0	2	0	3	3	0	0	0	2	2	0	0	0	31
THA09-65	0	0	0	0	2	6	0	0	0	4	0	0	0	0	7
THA09-68	1	0	0	0	0	1	0	2	0	0	0	0	0	1	7
THA09-69	0	0	0	0	1	0	0	0	0	0	0	0	0	0	19

Data Repository 3a, continued.

Sample number	Phytolith morphotype (compound variable)**								Total phyto-liths	Dia-toms	Sponge spicules	Chryso phytes	DSC total	Total bio-silica
	CO-1 B (POOID -ND)	CO-2 (POOID -ND)	COF-1B (BAMB/ B)	KR-1 (POOID -ND)	KR-2 (POOID -ND)	Py-1 (POOID -ND)	SA-1 (CHLO R)	Bl-1 (POOI D-D)						
THA09-03	0	0	0	1	0	0	0	0	233	1	0	1	2	235
THA09-05	p	--	--	--	--	--	--	--	--	--	--	--	--	--
THA09-10	0	0	0	0	0	0	0	0	191	0	0	4	4	195
THA09-12	1	0	0	2	0	0	0	0	231	1	0	1	2	233
THA09-14	3	0	0	0	0	0	0	2	288	3	2	3	8	296
THA09-15	5	0	0	7	0	0	0	0	230	2	0	5	7	237
THA09-17	3	0	0	2	0	3	0	1	252	25	0	6	31	283
THA09-18	4	2	1	15	0	0	0	0	222	33	0	6	39	261
THA09-21	1	0	0	0	0	0	0	0	262	177	2	4	183	445
THA09-25	0	0	0	2	0	0	0	0	232	46	8	9	63	295
THA09-30	p	--	--	--	--	p	--	--	--	p	p	p	p	--
THA09-32	0	0	0	1	0	0	0	0	183	81	8	10	99	282
THA09-34	18	3	0	26	0	6	0	0	266	1	3	0	4	270
THA09-35	0	0	0	0	0	1	0	0	253	1	0	7	8	261
THA09-37	20	0	0	18	0	0	1	0	269	0	0	14	14	283
THA09-40	p	--	--	p	p	--	--	--	--	--	--	p	p	--
THA09-44	9	0	0	1	0	0	0	0	274	140	8	77	225	499
THA09-45	1	0	0	0	0	0	0	0	264	123	5	6	134	398
THA09-46	1	0	0	1	0	1	0	0	270	63	3	22	88	358
THA09-50	0	0	0	2	0	0	1	0	228	635	3	7	645	873
THA09-52	2	0	0	0	0	0	0	0	238	75	227	9	311	549
THA09-55	2	0	0	5	0	0	0	0	227	35	4	27	66	293
THA09-57	0	0	0	3	0	0	0	0	232	78	11	39	128	360
THA09-59	6	0	0	4	0	0	0	0	240	3	1	2	6	246
THA09-65	0	0	0	0	0	0	0	0	217	195	4	16	215	432
THA09-68	2	0	0	0	0	0	0	0	220	331	3	49	383	603
THA09-69	0	0	0	3	0	0	0	0	257	105	0	16	121	378

Data Repository 3b. Comparison of phytolith preservation category with paleosol soil order. As noted in the text, no relationship is observed between paleosol type and preservation category.



Data Repository 4. Raw phytolith counts grouped by plant category. FI total, *Costus*-type bodies, FI minus *Costus*, and GSSC were used for vegetation reconstruction. *p = present but not part of count.

Sample number	Meter level	Plant category*								
		FI total	*Costus*-type bodies	FI minus *Costus*	Palm	FI minus *Costus,* palm	GSSC	Potential grass	Sedge	Other
THA09-03	0.31	144	0	144	7	137	58	9	7	15
THA09-05	1.41	p	--	p	p	p	p	p	--	p
THA09-10	3.9	128	0	128	5	123	29	21	8	5
THA09-12	6	141	0	141	13	128	32	42	1	15
THA09-14	7.29	147	10	137	7	130	77	32	3	29
THA09-15	8.18	128	1	127	8	119	50	45	1	6
THA09-17	9.25	145	83	62	2	60	45	13	1	48
THA09-18	9.7	154	125	29	5	24	42	3	0	23
THA09-21	10.3	206	62	144	9	135	14	20	3	19
THA09-25	11.17	158	0	158	4	154	18	46	1	9
THA09-30	14.1	p	--	p	p	p	p	p	p	p
THA09-32	15.03	166	155	11	1	10	5	1	1	10
THA09-34	16.86	17	0	17	0	17	162	13	2	72
THA09-35	17.6	98	0	98	8	90	116	12	5	22
THA09-37	18.25	24	0	24	1	23	180	20	p	45
THA09-40	19.91	p	p	p	p	p	p	p	p	p
THA09-44	22.99	205	186	19	1	18	30	17	1	21
THA09-45	23.3	211	16	195	p	195	30	5	2	16
THA09-46	24.65	147	71	76	2	74	63	31	1	28
THA09-50	27.74	60	3	57	5	52	116	29	3	20
THA09-52	29.38	111	0	111	5	106	22	68	6	31
THA09-55	30.89	139	1	138	2	136	58	17	0	13
THA09-57	33.19	199	158	41	3	38	17	3	1	12
THA09-59	34.34	157	0	157	1	156	41	21	1	20
THA09-65	38.9	186	156	30	0	30	7	14	0	10
THA09-68	40.58	197	160	37	2	35	9	6	5	3
THA09-69	43.54	213	8	205	4	201	22	11	2	9

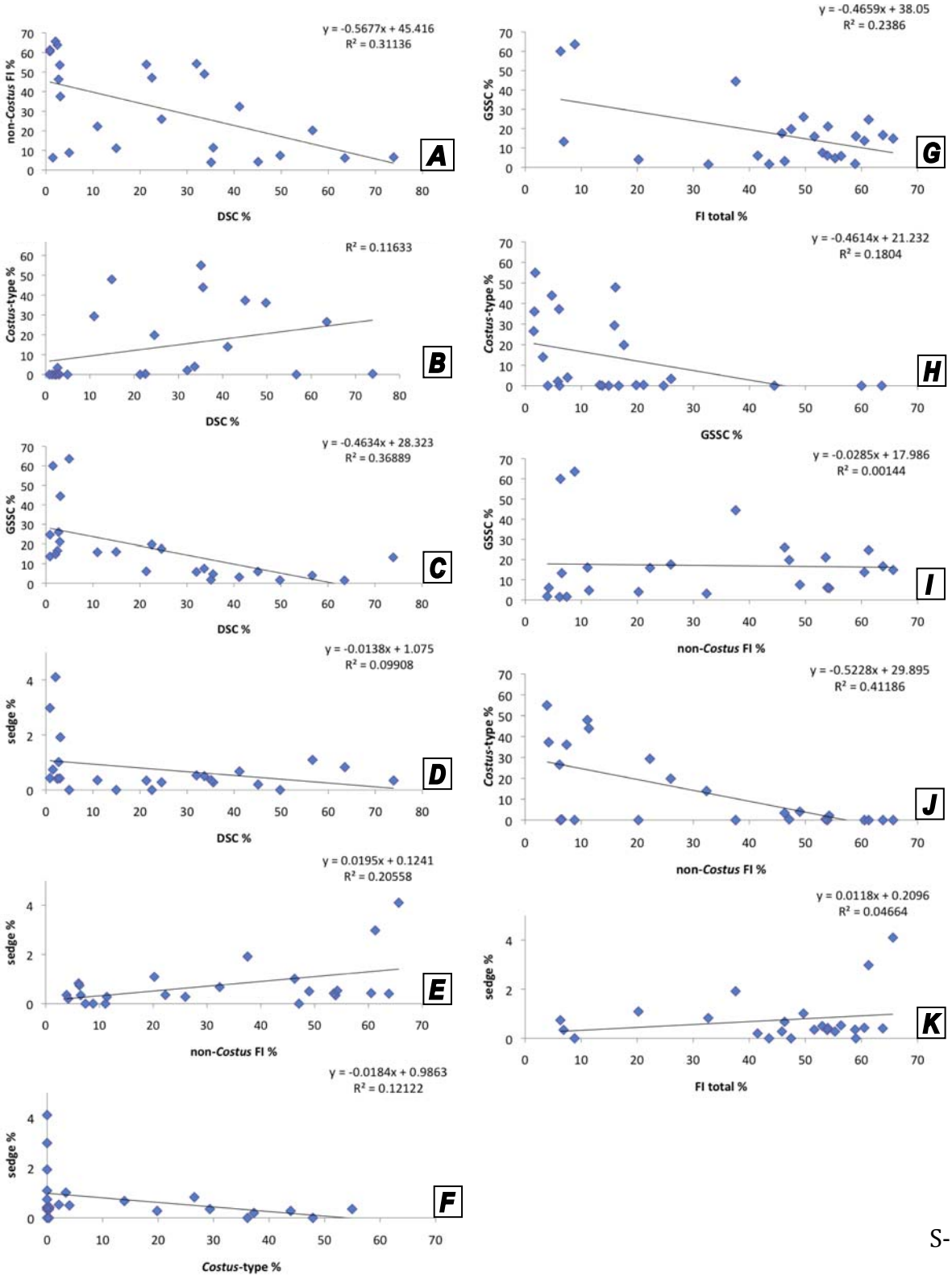
Data Repository 5. Percent frequency (of total biosilica) of biosilica morphotypes from the Middle Eocene Timberhills A locality, Montana. *p = present but not part of count.

Sample number	Meter level	Plant category*									Phyto-lith Total	Dia-tom	Sponge spicules	Chryso-phytes	DSC total
		FI total	*Costus*-type bodies	FI minus *Costus*	Palm	FI minus *Costus*, palm	GSSC	Poten-tial grass	Sedge	Other					
THA09-03	0.31	61.28	0.00	61.28	2.98	58.30	24.68	3.83	2.98	6.38	99.15	0.43	0.00	0.43	0.85
THA09-05	1.41	p	--	p	p	p	p	p	--	--	--	--	--	--	--
THA09-10	3.9	65.64	0.00	65.64	2.56	63.08	14.87	10.77	4.10	2.56	97.95	0.00	0.00	2.05	2.05
THA09-12	6	60.52	0.00	60.52	5.58	54.94	13.73	18.03	0.43	6.44	99.14	0.43	0.00	0.43	0.86
THA09-14	7.29	49.66	3.38	46.28	2.36	43.92	26.01	10.81	1.01	9.80	97.30	1.01	0.68	1.01	2.70
THA09-15	8.18	54.01	0.42	53.59	3.38	50.21	21.10	18.99	0.42	2.53	97.05	0.84	0.00	2.11	2.95
THA09-17	9.25	51.24	29.33	21.91	0.71	21.20	15.90	4.59	0.35	16.96	89.05	8.83	0.00	2.12	10.95
THA09-18	9.7	59.00	47.89	11.11	1.92	9.20	16.09	1.15	0.00	8.81	85.06	12.64	0.00	2.30	14.94
THA09-21	10.3	46.29	13.93	32.36	2.02	30.34	3.15	4.49	0.67	4.27	58.88	39.78	0.45	0.90	41.12
THA09-25	11.17	53.56	0.00	53.56	1.36	52.20	6.10	15.59	0.34	3.05	78.64	15.59	2.71	3.05	21.36
THA09-30	14.1	p	--	p	p	p	p	p	p	p	--	p	p	p	--
THA09-32	15.03	58.87	54.96	3.90	0.35	3.55	1.77	0.35	0.35	3.55	64.89	28.72	2.84	3.55	35.11
THA09-34	16.86	6.30	0.00	6.30	0.00	6.30	60.00	4.81	0.74	26.67	98.52	0.37	1.11	0.00	1.48
THA09-35	17.6	37.55	0.00	37.55	3.07	34.48	44.44	4.60	1.92	8.43	96.93	0.38	0.00	2.68	3.07
THA09-37	18.25	8.48	0.00	8.48	0.35	8.13	63.60	7.07	p	15.90	95.05	0.00	0.00	4.95	4.95
THA09-40	19.91	p	p	p	p	p	p	p	p	p	--	--	--	p	--
THA09-44	22.99	41.08	37.27	3.81	0.20	3.61	6.01	3.41	0.20	4.21	54.91	28.06	1.60	15.43	45.09
THA09-45	23.3	53.02	4.02	48.99	p	48.99	7.54	1.26	0.50	4.02	66.33	30.90	1.26	1.51	33.67
THA09-46	24.65	41.06	19.83	21.23	0.56	20.67	17.60	8.66	0.28	7.82	75.42	17.60	0.84	6.15	24.58
THA09-50	27.74	6.87	0.34	6.53	0.57	5.96	13.29	3.32	0.34	2.29	26.12	72.74	0.34	0.80	73.88
THA09-52	29.38	20.22	0.00	20.22	0.91	19.31	4.01	12.39	1.09	5.65	43.35	13.66	41.35	1.64	56.65
THA09-55	30.89	47.44	0.34	47.10	0.68	46.42	19.80	5.80	0.00	4.44	77.47	11.95	1.37	9.22	22.53
THA09-57	33.19	55.28	43.89	11.39	0.83	10.56	4.72	0.83	0.28	3.33	64.44	21.67	3.06	10.83	35.56
THA09-59	34.34	63.82	0.00	63.82	0.41	63.41	16.67	8.54	0.41	8.13	97.56	1.22	0.41	0.81	2.44
THA09-65	38.9	43.06	36.11	6.94	0.00	6.94	1.62	3.24	0.00	2.31	50.23	45.14	0.93	3.70	49.77
THA09-68	40.58	32.67	26.53	6.14	0.33	5.80	1.49	1.00	0.83	0.50	36.48	54.89	0.50	8.13	63.52
THA09-69	43.54	56.35	2.12	54.23	1.06	53.17	5.82	2.91	0.53	2.38	67.99	27.78	0.00	4.23	32.01

Data repository 6. Plant category data (as percent of total FIs and GSSCS) used to infer vegetation types for the Middle Eocene Timberhills A locality, Montana, with 95% confidence intervals (C.I.) calculated following Strömberg (2009). *p = present but not part of count.

Sample number	Meter level	Plant category, % of FI+GSSC							
		Costus-type bodies	*Costus*-type 95% C.I.	FI minus *Costus*	FI minus *Costus*-type 95% C.I.	GSSC	GSSC 95% C.I.	FI+GSSC count	Phytolith total
THA09-03	0.31	0.0	N/A	71.3	(63.5-78.7)	28.7	(22.8-35,6)	202	233
THA09-05	1.41	--	N/A	p	N/A	p	N/A	--	--
THA09-10	3.9	0.0	N/A	81.5	(73.2-89.8)	18.5	(12.7-24.8)	157	191
THA09-12	6	0.0	N/A	81.5	(74.0-89.6)	18.5	(12.7-24.3)	173	231
THA09-14	7.29	4.5	(1.8-7.1)	61.2	(54.0-67.9)	34.4	(27.7-41.3)	224	288
THA09-15	8.18	0.6	(0-1.7)	71.3	(62.9-79.8)	28.1	(21.3-34.8)	178	230
THA09-17	9.25	43.7	(35.8-51.6)	32.6	(25.8-39.5)	23.7	(17.4-30.5)	190	252
THA09-18	9.7	63.8	(56.6-70.9)	14.8	(10.2-20.4)	21.4	(15.8-27.6)	196	222
THA09-21	10.3	28.2	(22.3-34.1)	65.5	(58.6-72.7)	6.4	(3.2-9.5)	220	262
THA09-25	11.17	0.0	N/A	89.8	(81.5-97.7)	10.2	(6.3-14.8)	176	232
THA09-30	14.1	--	N/A	p	N/A	p	N/A	--	--
THA09-32	15.03	90.6	(84.8-95.9)	6.4	(2.9-9.9)	2.9	(0.6-5.8)	171	183
THA09-34	16.86	0.0	N/A	9.5	(5.0-14.0)	90.5	(81.6-98.3)	179	266
THA09-35	17.6	0.0	N/A	45.8	(38.6-52.8)	54.2	(46.5-61.2)	214	253
THA09-37	18.25	0.0	N/A	11.8	(7.8-16.2)	88.2	(81.4-95.6)	204	269
THA09-40	19.91	p	N/A	p	N/A	p	N/A	--	--
THA09-44	22.99	79.1	(72.6-85.5)	8.1	(4.7-11.5)	12.8	(8.5-17.4)	235	274
THA09-45	23.3	6.6	(3.7-10.4)	80.9	(75.1-87.1)	12.4	(8.3-16.6)	241	264
THA09-46	24.65	33.8	(27.1-41.0)	36.2	(29.3-42.9)	30.0	(23.8-36.7)	210	270
THA09-50	27.74	1.7	(0-4.0)	32.4	(25.0-39.8)	65.9	(58.0-74.4)	176	228
THA09-52	29.38	0.0	N/A	83.5	(72.9-94.0)	16.5	(10.5-23.3)	133	238
THA09-55	30.89	0.5	(0-1.5)	70.1	(63.5-77.7)	29.4	(22.8-35.5)	197	227
THA09-57	33.19	73.1	(66.7-79.6)	19.0	(13.7-24.1)	7.9	(4.6-11.6)	216	232
THA09-59	34.34	0.0	N/A	79.3	(71.7-85.9)	20.7	(15.2-26.5)	198	240
THA09-65	38.9	80.8	(73.8-87.6)	15.5	(10.6-21.2)	3.6	(1.0-6.7)	193	217
THA09-68	40.58	77.7	(70.9-83.5)	18.0	(13.1-22.8)	4.4	(1.9-7.3)	206	220
THA09-69	43.54	3.4	(1.3-6.0)	87.2	(82.1-92.3)	9.4	(6.0-13.2)	235	257

Data repository 7. Correlations of different biosilica types calculated from percentage of total biosilica. Two-tailed p-values are reported. A, DSC and non-*Costus* FIs (p=0.005). B, DSC and *Costus*-type bodies (p=0.103). C, DSC and GSSC (p=0.002). D, DSC and sedge (p=0.134). E, non-*Costus* FIs and sedge (p=0.026). F, *Costus*-type bodies and sedge (p=0.096). G, total FIs and GSSC (p=0.016). H, GSSC and *Costus*-type bodies (p=0.038). I, non-*Costus* FIs and GSSCs (p=0.860). J, non-*Costus* FIs and *Costus*-type bodies (p=0.001). K, total FIs and sedges (p=0.311). Note that total sedge population is very low.

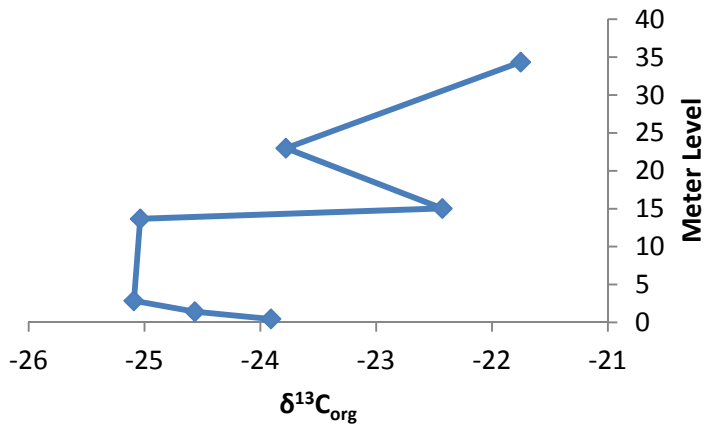


Data Repository 8. Carbon Isotope Data.

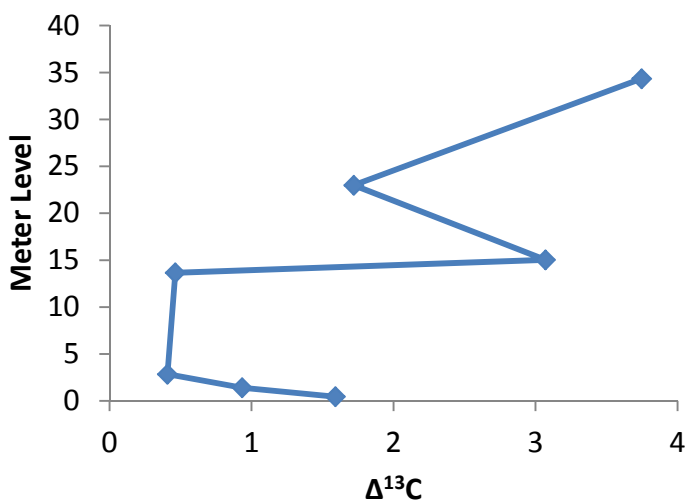
meter level	sample	δ^{13}Corg (mean)	wt. % C	Δ^{13}C (org-atm)
0.45	THA09-04	-23.91	0.07	1.59
1.41	THA09-05	-24.57	0.07	0.93
2.85	THA09-06	-25.09	0.07	0.41
13.65	THA09-92	-25.04	0.05	0.46
15.03	THA09-32	-22.43	0.06	3.07
22.99	THA09-44	-23.78	0.08	1.72
34.34	THA09-59	-21.75	0.04	3.75

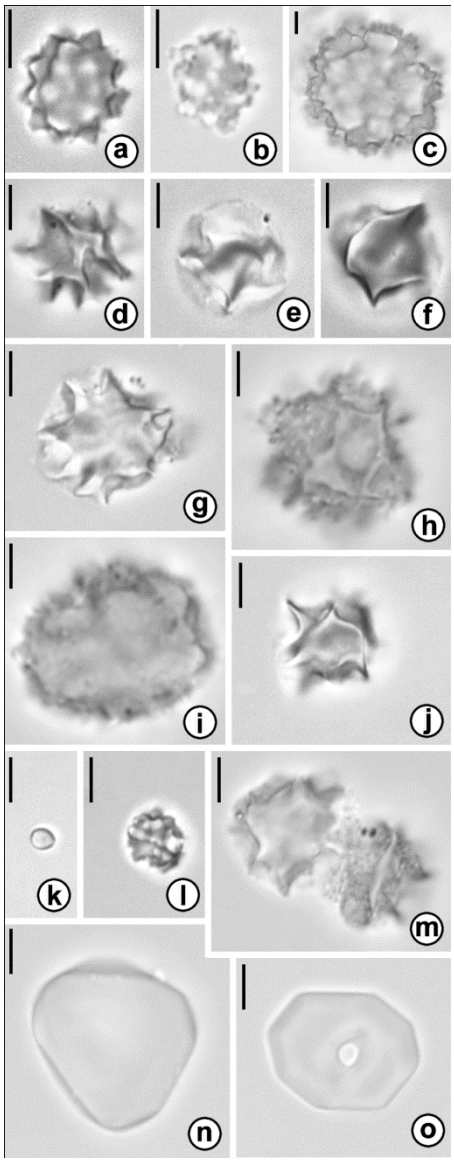
Mean values based on up to three replicate analyses.

Data Repository 9. Carbon isotope data plotted as a function of stratigraphic position.



A) Raw isotopic values measured from organic root traces.



B) Calculated difference between measured isotopic values and the calculated "typical" C_3 plant value for the Middle Eocene of -25.5‰.

Data Repository 10. Examples of modern spherical tropical monocot phytoliths from leaves that were compared with fossil morphotypes. (a) echinate sphere of *Ceroxylon alpinum* palm (Arecaceae). (b) Rugose subspherical phytolith from the ginger *Alpinia glabrescens* (Zingiberaceae). (c) Large rugose, somewhat folded sphere of *Maranta arundinacea* (Marantaceae). (d-f) Spherical body with irregular sinuous facets of *Costus microcephalus* (Costaceae) showing range of morphologies. (g-i) Phytoliths from *Canna indica* (Cannaceae). (g) Morphotype similar to *Costus* phytoliths. (h) A more irregular sphere with rugose surface and facets. (i) Rugose subspherical phytolith. (j-l) Phytoliths from *Phenakospermum guianensis* (Strelitziaceae). (j) Morphotype similar to *Costus* phytoliths. (k) Very small, smooth, spherical body of clear silica. (l) tubercle-covered spherical body. (m-o) Phytoliths from *Strelitzia reginae* (Strelitziaceae). (m) Morphotype similar to *Costus* phytoliths. (n, o) Smooth subspherical bodies of clear silica. Scale bars: 5 µm.