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Late Eocene to middle Miocene (33 to 13 million years ago) vegetation and climate development on the North American Atlantic Coastal Plain (IODP Expedition 313, Site M0027)

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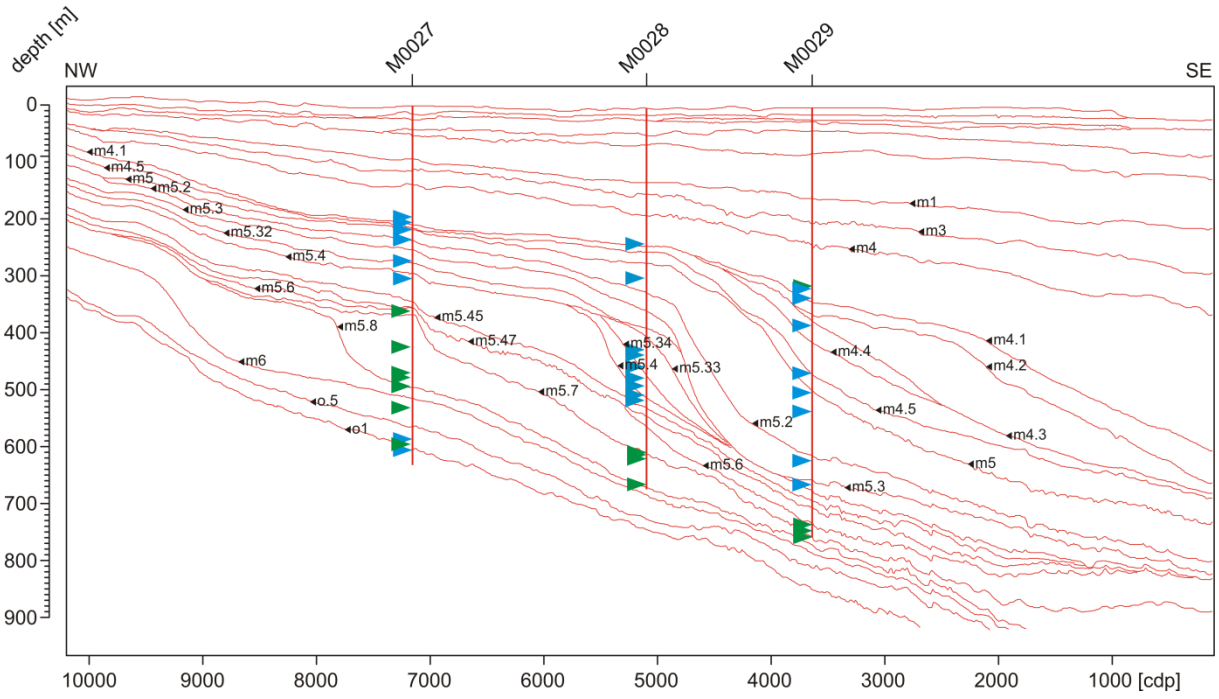
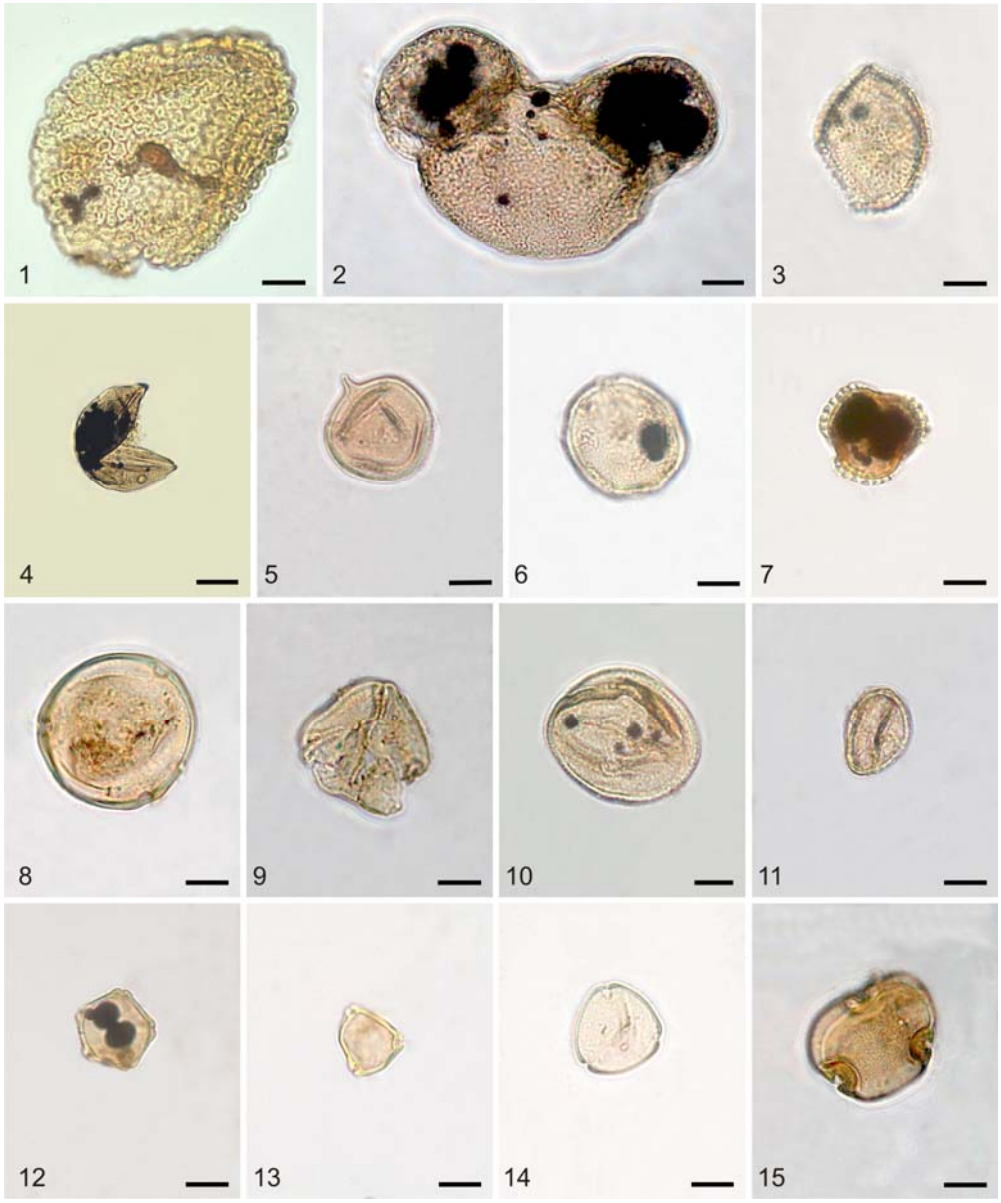


Supplementary Figure S1. Depth-converted seismic stratigraphic framework for IODP expedition 313 boreholes (after Mountain et al., 2010 and Fang et al., 2013). Depths of samples with *Ulmus* pollen percentages >2,5 % are marked with blue triangles, samples with *Tsuga* percentages >1% are marked with green triangles (bisaccate pollen excluded from reference sum). Pollen data for Sites M0028 and M0029 were gathered in the framework of the IODP expedition 313 onshore science party (Mountain et al., 2010), additional pollen data for Site M0029 derive from Fang et al. (2013).



Supplementary Figure S2. Palynomorphs from Sites M0027 and M0029, New Jersey shallow shelf, scale bar: 10 µm. 1: *Tsuga heterophylla* type (M0029, core 209, ~733 mbsf), 2: *Pinus* (M0027, core 95, ~272 mbsf) 3: *Arecipites* type (M0027, core 115, ~332 mbsf), 4: pyrite-filled *Inaperturopollenites* type (pyrite-filled, M0027, core 80, ~225 mbsf), 5: *Taxodium* (with well-preserved papilla, M0027, core 101, ~290 mbsf), 6: *Liquidambar* (same sample as 5), 7: *Ilex* (M0027, core 109, ~315 mbsf), 8: *Carya* (M0027, core 94, ~271 mbsf), 9: *Nyssa*: (M0027, core 209, ~586 mbsf), 10: *Fagus* (same sample as 5), 11: *Quercus* (small type, same sample as 2), 12: *Alnus* (same sample as 8), 13: *Betula* (same sample as 7); 14: *Engelhardia* (same sample as 5); 15: *Tilia* (same sample as 2)

Supplementary Text 1. Pollen differentiation (*Tsuga*, inaperturate pollen, *Nyssa*/*Fagus*, *Ulmus*/*Zelkova*)

Several authors distinguish numerous *Tsuga* (*Zonapollenites*) species for the Miocene (e.g., Krutzsch, 1971), but we decided to assign *Tsuga* pollen grains to three types similar to present-day species. While *Tsuga mertensiana* pollen can be separated from other *Tsuga* species by its bisaccate morphology, present-day *T. canadensis* and *T. heterophylla* pollen (Suppl. Fig. S2) cannot easily be discriminated. Both are monosaccate, verrucate and characterized by an encircling frill-like structure. We used a more differentiated "frill" and the presence of microechinate processes on the muri to assign monosaccate *Tsuga* grains to the *T. heterophylla* type, following e.g. White and Ager (1994) and Barnett (1989).

Taxodium pollen was differentiated from other inaperturate pollen types, but particularly when pyrite grains were present inside the pollen grains (compare section 4 and Suppl. Fig. S2), the identification was hampered, so that in some samples, *Taxodium* pollen may have been assigned to the "other inaperturate pollen type". Therefore, in the pollen diagram (Fig. 2) pollen of the *Inaperturopollenites* type was grouped together with *Taxodium* and *Cupressacites* due to the morphological similarities of these pollen types (see also Larsson et al., 2011). Inaperturate grains were assigned to *Sequoia* when a long papilla was preserved (e.g., Krutzsch, 1971), in contrast to the shorter, often invisible papilla present in *Taxodium* and related taxa. The differentiation of *Sequoia* pollen is important since this taxon is not directly associated with swamps, unlike *Taxodium* and *Cupressacites*. Therefore *Sequoia* is associated with the conifer forest type, and not with the swamp/wet forest type (see Fig. 3).

While it is generally possible to distinguish *Nyssa* pollen grains from *Fagus* pollen grains (e.g., McAndrews et al, 1973; Traverse, 1994; Beug 2004), the differentiation was hampered in a few samples with slightly degraded pollen or pollen grains filled with pyrite (see Suppl. Fig. S2). We have nevertheless decided to aim at a differentiation, since *Nyssa* is rather associated with swamp vegetation, while *Fagus* is characteristic of mid-latitude deciduous forests. *Zelkova* and *Ulmus* were not separated and all counted as *Ulmus*.

Supplementary Table S1. Assignment of pollen types at Site M0027 to vegetation types.

Vegetation type	Conifer-forest	High-altitude conifer forest	Swamp/wet forest	Deciduous-evergreen mixed forest	Mesophytic understorey and non-steppic herbal taxa	Coastal or steppic taxa
associated pollen	*Cedripites/ Cedrus* *Pinus* *Sciadopitys* *Sequioa* type *Tsuga* *Podocarpus*	*Abies* *Picea* *Larix*	*Alnus* *Acorus* *Betula* *Cupressacites* Cyrillaceae *Inaperturo-pollenites* *Myrica* *Nyssa* *Nympha* type *Salix* *Sapotaceae* *Symplocos* type *Taxodium* type	*Acer* *Arecaceae* v. *Arecipites* *Carpinus* *Carya* *Castanea* *Celtis* *Cornus* *Corylus* *Cycadopites* type *Engelhardia* Ericaceae *Eucommia* Fagaceae v. *Fagus* *Fraxinus* *Ginkgo* *Ilex* *Iuglans* *Liquidambar* *Liriodendron* type *Magnolia* *Monocolpopollenites*	Pteridophyta *Sphagnum* *Osmunda* Asteraceae (excl. *Artemisia*) Poaceae *Sparganium* Apiaceae Menyanthaceae	Chenopo-diaceae *Ephedra* *Artemisia*

	Platanus
	Platycarya
	Pterocarya
	Quercus
	Quercoidites
	Rhus
	Taxus
	Tilia
	Tricolporopollenites cingulum type
	Ulmus type.

1 v. = varia

Supplementary Table S2. List of fossil palynomorphs, next living relatives, sources of climatic range data

Taxon identified in the record	NLR used	Climate range source
Osmunda	North American species of *Osmunda* s.l.	5
Cycadopites	Cycads: N American species; Chinese species; Australian species	1,2,3
Ginkgo	*G. biloba*	2
Abies	N American species of *Abies*	1
Cedrus/Cedripites	*Cedrus atlantica, C. brevifolia, C. deodara, C. libani*	4
Inaperturopollenites hiatus	*Metasequoia glyptostroboides*	2
Sciadopitys	*Sciadopitys verticillata*	4
Sequoiapollenites	*Sequoia sempervirens*	1
Taxus	N American species of *Taxus*	1
Tsuga canadensis	*Tsuga canadensis*	1
Tsuga heterophylla/diversifolia type	*Tsuga heterophylla* + *T. diversifolia*	1
Tsuga mertensiana	*T. mertensiana*	1
Arecipites (Arecaceae)	All Australian genera, all Chinese genera, plus these genera from these areas: New Zealand, *Rhopalostylis*; North, Central & South America, *Sabal, Serenoa, Brahea, Washingtonia, Trithrinax;* N Africa, *Phoenix* (also from China)	1, 2, 3, 4, 6
Arecaceae varia	As above	1, 2, 3, 4, 6
Acer	N American species of *Acer*	1
Acorus	*Acorus americanus*	5
Alnus	N American species of *Alnus*	1
Betula	N American species	1
Carpinus	N American species of *Carpinus* + *Ostrya*	1
Carya	N American species of *Carya*	1

Castanea/*Tricolporites cingulum*	N American species of *Castanea*	1
Celtis	N American species of *Celtis*	1
Cornus	N American species of *Cornus* (woody only)	1
Corylus	N American species of *Corylus*	1
Engelhardia (*Momipites punctatus*?)	Chinese species of *Engelhardia*	2
Eucommia type	*Eucommia ulmoides*	2
Fagus	N American species of *Fagus*	1
Fraxinus	N American species of *Fraxinus*	1
Ilex	N American species of *Ilex*	1
Juglans	N American species of *Juglans*	1
Liriodendropollis	*Liriodendron tulipifera*	1
Liquidambar	*Liquidambar styraciflua*	1
Magnolia	N American species of *Magnolia*	1
Menyanthes type	*Menyanthes trifoliate*	5
Myrica/*Triatriopollenites*	N American species of *Myrica*	1
Nuphar	N American species of *Nuphar*	5
Nymphaea	N American species of *Nymphaea*	5
Nyssa	N American spp of *Nyssa*	1
Ostrya	N American species of *Carpinus* + *Ostrya*	1
Planera	*Planera aquatic*	1
Platycarya	*Platycarya strobilacea*	2
Prunus	N American species of *Prunus*	1
Pterocarya	Chinese species of *Pterocarya*	2
Quercus (partly rugulate, small)	N American species of *Quercus*	1
Quercus (big)	N American species of *Quercus*	1
Rhus type (Anacardiaceae)	N American species of *Rhus*	1
Salix	N American species of *Salix*	1

Symplocos and *Porocolpopollenites*	*Symplocos tinctoria*	1
T. villensis (*Castanopsis*, Fagaceae)	*Castanopsis chrysophylla*	1
Tilia	N American species of *Tilia*	1
Tricolpites retiformis (*Platanus*)	N American species of *Platanus*	1
Ulmus	N American species of *Ulmus*	1

Data sources: 1 Thompson et al. (1999, 2000, 2012); 2 Fang et al. (2011); 3 Australian National Herbarium online (http://www.anbg.gov.au/cpbr/herbarium/) + ANUCLIM 6.1 (http://fennerschool.anu.edu.au/research/products/anuclim-vrsn-61); 4 GBIF + WorldCLIM (http://www.gbif.org/resources/2921); 5 NRC Canada (www.nrc-cnrc.gc.ca/eng/); 6 Reichgelt et al. (2013).

Following pages: palynomorph dataset for Site M0027

SITE	Core	Section	Depth	Depth 2	AGE(IntAgeModel-File) Based on Browning et al. 2013	Sequence	DEPTH (mbsf)	*Pinus* A (BIG)	*Pinus* B (small)	*Podocarpus (?)*	*Picea*	*Abies*	*Tsuga mertensiana*	*Cedrus/Cedripites*	*Tsuga canadensis*	*Tsuga heterophylla/diversifolia* t	*Sciadopitys*	*Larix*	*Cupressacites*	*Taxodium* type	*Inapertupollenites* (mainly *hiatus*	*Sequoia/Sequoiapollenites*	*Taxus*	*Ilex*	*Cycadopites*	*Ginkgo*	*Magnolia*	*Liriodendropollis*	*Liliacidites*	*Liliopollis*	*Acer*	*Quercus* (rugulate)	*Quercus* big	*Quercus* small (steppic?)	*Quercus* very small (steppic?)	*Quercus* round	Tricolpate slender (*Tricolpites he*	*Quercoidites* type big	*Quercoidites* type small	*Tricolpites retiformis (Platanus t*	*Tricolpites librarenis* type (Fagac	*Tricolpites/Quercoidites microhe*	*Tricolpites/Quercoidites henrici*	*T. villensis* (*Castanopsis*, Fagac	*Fagus*	*Nyssa*	*Cornus*
M0027	41	1	16	18	11,6981	m1	79,67	3	0	0	0	0	0	0	0	0	1	0	1	3	15	2	0	0	0	0	8	0	0	0	0	0	83	44	13	5	1	9	1	0	0	0	0	12	0	2
M0027	65	2	24	25	12,8863	m4.1	193,85	8,5	0	0	1	0	0	1	0	0	0	0	0	6	2	0	0	1	0	0	3	0	0	2	0	0	66	59	12	7	1	6	0	0	0	0	0	7	0	0
M0027	66	1	70	71	12,89481	m4.1	195,6	7,5	2,5	0	1	0	0	0	0	0	0	1	3	2	7	0	0	0	0	1	2	0	2	0	0	4	35	16	5	1	0	1	4	1	1	0	0	15	27	0
M0027	67	2	68	70	12,89681	m4.1	196,01	10	7	0	0	0	0	0	2	0	1	0	0	1	9	0	1	0	0	0	4	0	0	0	0	7	92	26	3	1	1	0	4	2	0	0	0	1	13	5	7
M0027	67	2	100	101	12,91184	m4.1	199,1	7,5	5,5	0	1	0	0	0	1	1	1	0	1	2	10	0	0	1	1	0	11	0	0	0	0	6	54	17	1	10	0	2	4	0	0	0	0	0	20	36	0
M0027	69	1	40	41	12,93767	m4.1	204,41	33	17	1	2	0	0	0	0	0	0	0	0	1	7	0	0	1	0	0	8	3	0	0	0	1	68	29	10	6	1	8	3	0	0	0	0	0	20	40	0
M0027	70	1	49	50	12,95319	m4.1	207,6	33	2,5	0	1	1	0	0	0	0	0	5	3	1	11	0	0	1	1	0	4	0	0	0	0	0	73	33	2	6	1	7	4	0	0	0	0	0	10	7	0
M0027	70	2	7	8	12,95854	m4.1	208,7	21	1,5	0	2	1	0	0	0	0	1	2	2	2	12	0	0	2	2	0	10	1	0	0	0	7	98	41	3	14	2	6	4	0	0	1	6	0	0	1	0
M0027	71	1	17	18	13,20324	m4.5	209,1	55	31	0	2	1	0	0	0	0	0	0	1	9	8	0	0	0	0	0	6	0	0	0	0	1	68	40	15	6	2	1	10	1	0	3	5	0	0	1	0
M0027	72	1	22	24	13,25431	m4.5	210,7	35	9,5	0	5	0	0	0	0	0	0	0	1	11	5	0	0	3	0	0	2	0	0	0	0	0	53	36	23	3	7	4	6	0	0	0	0	0	0	3	0
M0027	73	1	57	58	13,27824	m4.5	211,45	47	3	0	1	0	0	0	0	0	2	0	2	2	12	0	0	0	0	0	7	0	1	0	0	0	95	37	6	0	1	9	2	0	0	0	0	0	3	0	2
M0027	75	2	82	83	13,60206	m5	218,53	54	31	1	2	0	0	1	1	0	3	0	0	4	5	0	3	0	0	0	5	0	0	0	0	0	87	29	9	13	0	6	4	1	0	2	0	0	9	7	1
M0027	77	1	90	91	13,67297	m5	223,21	57	26	1	10	0	0	0	0	0	2	0	0	1	13	0	0	1	0	0	5	0	1	0	0	0	68	37	15	3	1	3	5	1	0	0	0	0	4	3	1
M0027	80	1	92	93	14,82296	m5.2	226,28	27	8,5	3	1	0	0	0	0	0	1	0	0	3	6	0	1	2	0	0	8	0	0	0	0	0	70	54	28	3	2	1	3	0	1	1	0	0	4	3	1
M0027	82	2	24	25	14,94709	m5.2	233,2	8	5	0	1	0	0	1	0	1	0	0	4	21	10	0	1	1	2	0	1	0	0	0	0	2	52	45	15	7	1	4	6	1	0	0	2	2	3	1	0
M0027	83	3	11	12	15,60359	m5.3	236,51	6	4	0	0	0	0	0	0	0	1	0	0	1	7	1	0	0	0	0	4	0	0	0	0	0	86	49	14	7	4	6	3	0	0	0	0	0	3	4	0
M0027	84	2	41	42	15,62445	m5.3	238,6	11	2	0	0	0	0	0	0	0	0	0	1	4	8	0	0	0	0	0	3	0	0	0	0	2	79	38	19	9	0	4	1	0	0	3	2	0	5	5	0
M0027	85	3	27	28	15,66557	m5.3	242,72	20	2	1	0	0	0	0	0	0	1	1	0	4	2	0	0	0	0	0	1	0	0	1	0	2	93	31	16	8	11	4	7	0	0	0	0	0	1	3	0
M0027	88	1	50	51	15,74082	m5.3	250,26	36	3	0	0	0	0	1	0	0	1	0	1	10	17	0	0	0	0	0	12	0	0	0	0	0	86	44	16	6	4	6	5	0	0	0	0	0	4	0	0
M0027	91	RCC	9	10	16,53896	m5.33	262,05	33	7	0	1	1	0	0	0	0	0	0	0	2	0	0	0	6	0	0	0	0	0	0	0	2	56	58	10	3	3	1	2	1	0	0	0	0	6	5	2
M0027	95	1	109	111	16,90412	m5.4	272,21	35	16	2	3	1	0	1	0	0	0	0	0	4	13	1	0	0	0	0	4	0	1	1	0	0	84	22	5	4	0	3	5	0	0	0	0	1	16	11	0
M0027	105	RCC	0	11	17,77264	m5.45	304,95	39	5,5	0	4	0	0	0	0	0	2	0	0	1	3	0	0	2	0	1	4	0	0	0	0	1	44	22	10	2	1	3	2	1	0	0	0	0	5	10	2
M0027	109		110	111	17,84543	m5.45	314,91	31	12	0	2	1	0	1	0	0	0	0	0	7	8	2	0	8	0	0	3	0	0	0	0	0	62	48	19	3	2	7	10	0	0	0	0	0	4	0	2
M0027	114	1	71	73	17,95403	m5.45	329,77	16	2	1	1	0	0	0	0	0	0	0	0	4	6	1	0	0	0	0	3	0	0	0	0	3	17	18	11	3	1	0	12	2	0	0	0	0	3	4	0
M0027	115	1	3	4	17,97135	m5.45	332,14	6,5	17	0	1	0	0	0	0	0	1	0	2	3	7	0	0	1	0	0	5	0	0	0	0	0	19	16	10	5	0	2	1	0	0	0	0	0	4	7	1
M0027	127	1	15	16	18,7502	m5.7	359,71	40	30	2	5	0	0	0	2	0	0	0	1	10	9	0	0	1	0	0	3	0	0	0	0	0	59	33	13	2	5	2	8	1	0	0	0	0	1	0	1
M0027	148	3	10	12	19,62026	m5.8	423,66	40	10	0	1	0	0	1	0	0	0	0	1	4	28	0	0	0	0	0	14	0	0	0	1	0	96	33	5	7	1	8	2	0	0	0	0	0	4	0	3
M0027	149	RCC	11	13	19,6408	m5.8	426,71	36	15	0	9	0	0	0	1	0	2	0	1	2	4	0	0	6	0	0	8	0	0	0	1	3	82	28	9	6	4	8	2	1	0	0	0	0	18	2	1
M0027	153	2	127	128	19,72077	m5.8	438,58	14	3,5	0	1	0	0	1	0	0	0	0	0	6	0	0	0	4	0	0	8	0	0	0	0	0	89	50	11	7	1	10	6	0	0	0	0	0	2	0	0
M0027	154		R	CC	19,74321	m5.8	441,91	38	11	0	4	0	0	0	0	0	1	0	0	4	3	0	0	3	0	0	4	0	0	0	0	1	88	34	9	6	4	6	3	0	0	0	0	0	16	5	0
M0027	159	2	120	121	19,84366	m5.8	456,82	16	2	0	3	0	0	0	0	0	0	0	0	1	9	0	0	3	0	0	2	0	0	0	0	1	107	30	20	3	5	2	4	0	0	0	0	1	2	4	1
M0027	160	2	32	34	19,85807	m5.8	458,96	14	8	1	6	1	0	1	0	0	3	0	0	9	9	0	0	2	0	1	6	0	0	0	0	1	55	42	20	6	4	7	4	1	0	0	4	1	11	3	2
M0027	160		R	CC	19,86427	m5.8	459,88	14	5,5	0	0	0	0	0	0	0	1	0	1	6	5	0	0	0	0	0	5	0	0	0	0	0	66	33	18	8	5	3	3	0	0	0	2	0	4	5	0
M0027	161	2	30	31	19,87862	m5.8	462,01	16	6	0	1	0	0	1	0	0	2	0	0	0	7	0	0	1	0	0	5	0	0	0	0	5	69	33	11	8	9	5	5	1	0	0	0	0	17	5	0
M0027	162	2	30	32	19,89668	m5.8	464,69	30	20	1	5	0	0	0	2	0	1	0	0	1	7	0	0	4	0	0	10	1	0	0	0	0	86	33	10	1	0	0	0	0	0	0	0	0	13	7	1
M0027	163	1	115	116	19,91534	m5.8	467,46	16	1,5	0	2	0	0	0	0	0	1	0	0	4	6	0	0	3	0	0	4	0	0	0	1	0	108	33	8	2	11	0	2	0	0	0	0	0	7	9	0
M0027	164	2	61	62	19,94235	m5.8	471,47	77	79	3	4	1	0	1	1	0	0	0	1	6	12	0	0	3	0	0	10	0	0	0	0	1	56	26	6	3	4	5	5	0	0	0	1	0	4	11	0
M0027	166	1	15	16	19,97031	m5.8	475,62	94	86	6	4	0	1	2	4	5	1	0	1	8	8	0	0	12	0	0	10	0	0	0	0	0	72	27	15	2	2	8	5	2	0	0	0	1	1	7	0
M0027	167	RCC	11	13	20,0106	m5.8	481,6	21	2,5	0	1	0	0	0	0	0	0	1	0	6	5	0	0	6	1	0	0	0	0	0	0	1	49	25	16	5	4	3	6	0	0	0	0	0	1	9	0
M0027	168	1	21	22	20,01168	m5.8	481,76	47	11	0	3	0	0	0	0	0	1	0	0	2	4	0	0	4	1	0	3	0	0	0	1	5	61	41	11	1	4	2	4	1	0	0	0	0	4	1	0
M0027	171	RCC	11	12	20,08381	m5.8	492,47	88	30	0	2	0	0	0	4	0	5	1	4	11	11	0	0	5	1	0	11	0	0	0	0	0	46	31	13	8	4	8	2	1	0	0	0	0	6	6	0
M0027	172	1	15	16	20,08461	m5.8	492,59	23	11	0	2	0	0	0	0	0	3	0	0	5	11	1	0	2	0	0	7	0	1	0	0	0	84	41	20	1	8	5	11	0	0	0	0	0	0	0	0
M0027	174	1	101	103	20,09933	m5.8	494,77	34	2,5	0	0	0	0	0	0	0	0	0	0	6	13	0	0	0	1	0	16	1	0	0	1	0	116	33	8	3	3	3	5	0	0	0	0	0	0	0	1
M0027	175	1	28	29	20,73142	m6	497,09	40	28	4	4	0	1	2	1	0	0	0	2	21	14	0	0	3	0	0	5	0	0	0	0	0	69	37	15	1	9	3	6	0	0	0	0	0	2	4	0

M0027	176	1	77	78	20,78153	m6	500,63	60	25	1	4	0	0	1	0	0	1	0	2	11	5	0	0	3	1	0	6	0	0	0	0	0	46	63	19	2	7	2	11	0	0	0	0	0	1	1	0
M0027	177	1	50	52	20,82088	m6	503,41	85	51	0	0	1	0	2	0	0	0	0	1	1	6	0	0	0	0	0	2	0	0	0	0	0	82	58	28	2	1	0	0	1	0	0	0	0	0	0	0
M0027	186	2	95	96	23,24697	unnamed	523,66	50	42	0	0	0	0	5	2	0	1	0	1	10	14	0	0	0	2	0	10	0	0	0	0	0	69	76	18	1	0	3	5	0	0	0	0	0	0	0	2
M0027	188	2	60	61	23,34046		529,21	339	197	1	5	2	1	6	7	5	4	0	3	19	14	1	0	3	0	0	5	0	0	0	0	0	38	40	23	1	4	4	7	0	0	0	0	0	1	1	1
M0027	190	1	119	120	23,43127	unnamed	534,6	73	47	4	2	0	0	1	0	0	0	0	3	8	12	0	0	1	1	2	11	0	0	0	0	7	33	43	20	4	6	2	10	0	0	3	1	0	0	0	0
M0027	191	2	90	91	23,47776	unnamed	537,36	23	22	0	3	0	0	0	0	0	1	0	0	5	13	0	0	0	2	0	5	0	0	0	0	0	12	38	16	0	3	1	8	2	0	1	1	0	0	2	0
M0027	193	2	78	79	28,28652	o.5	544,84	26	2,5	2	4	0	0	0	0	0	2	0	2	4	16	0	0	0	1	2	24	0	0	0	0	3	40	45	39	2	6	1	5	0	0	4	2	0	2	1	0
M0027	203	1	72	74	28,60716	o1	567,67	5	3	0	0	0	0	0	0	0	1	0	2	8	18	0	0	1	0	0	1	0	1	0	0	0	73	68	23	2	0	2	9	0	0	0	0	0	0	0	0
M0027	206	CC			28,7257	o1	576,11	152	40	2	5	3	0	0	1	0	5	1	0	1	2	0	0	2	0	0	0	0	1	0	0	0	39	27	9	3	1	3	6	0	0	0	0	1	4	0	0
M0027	208	2	133	134	28,85112	o1	585,04	15	6	0	2	0	0	1	0	0	0	0	1	4	10	1	0	4	0	0	5	0	0	0	0	0	25	28	20	1	3	2	4	0	0	0	0	0	0	2	0
M0027	209	1	104	105	28,86882	o1	586,3	26	6,5	0	2	1	0	0	0	0	3	0	0	7	9	1	0	2	0	0	13	0	0	0	0	0	61	48	14	3	6	13	0	0	1	0	0	0	2	2	0
M0027	212	CC			29,03301	unnamed	597,99	25	8,5	0	8	1	0	0	1	1	1	1	3	11	14	1	0	5	0	3	6	0	0	0	0	4	55	17	9	2	1	3	6	2	0	0	0	0	3	1	0
M0027	216	RCC			29,1736	unnamed	608	71	13	0	3	2	0	0	0	0	3	0	3	13	7	0	0	2	0	0	2	0	0	0	0	4	61	37	10	2	6	4	2	0	0	1	0	0	0	3	0
M0027	218	CC			29,28258	unnamed	615,76	48	5,5	0	6	0	0	0	0	1	2	0	0	12	11	0	0	3	0	0	10	0	0	0	1	0	33	45	23	4	5	3	12	2	0	0	0	0	2	0	0
M0027	221	1	10	11	32,27316	unnamed	623,46	68	23	0	1	0	1	7	0	0	0	0	2	6	14	2	0	0	0	0	13	0	0	0	0	0	48	28	9	0	5	4	7	0	0	0	0	0	1	0	2
M0027	221	2	100	101	32,28335	unnamed	624,36	16	6	0	1	0	0	0	1	0	1	0	8	18	24	2	2	0	0	2	6	0	0	0	0	4	38	35	37	8	5	1	6	0	0	1	5	0	1	0	0
M0027	223	2	36	37	33,92368	unnamed	626,77	6,5	4,5	2	1	0	0	1	0	0	0	0	5	15	12	0	0	0	0	1	10	0	0	0	0	0	17	24	12	1	4	2	5	0	0	4	0	0	2	0	0

Rhus type (Anacardiaceae)	*Foveotricolporites*	*Carya*	*Platycarya*	*Pterocarya*	*Celtis*	*Betula*	*Ostrya*	*Carpinus*	*Alnus*	*Juglans*	*Planera*	*Ulmus*	*Tilia*	*Myrica/Triatriopollenites*	*Corylus*	*Momipites*	*Symplocos (Porocolpopollenites*	*Porocolpopollenites jacksoneanu*	*Porocolpopollenites* varia	*Bochlensipollis*	*Engelhardia (Momipites punctat*	*Salix*	*Fraxinus*	*Liquidambar (amber tree)*	*Prunus*	*Castanea/Tricolporites cingulum*	*Cupuliferoidaepollenites* reticula	*Cupuliferoidaepollenites* sp.	*Erica*	other Tetrades (e.g. *Laxipollis*)	*Ephedra*	*Arecipites* (Palmae)	Arecaceae	monocolpate/sulcate pollen grai	*Loranthus* type	*Emmapollis*	Diaperturate	*Laevigopollenites*	Chenopodiacea	*Artemisia*	Asteraceae	Compositae	*Dryas*	Brassicaceae	*Saxifraga* type	Apiaceae	*Tricolporites edmundi* type (Aral	*Tricolporites pseudocingulum* ty	*Tricolporites cingulum* type	*Tricolporites bruhlensis* type (Cy	*Tricolporites exactus* type (Cleth	*Tricolporites reticulatus/Retitrico*	*Tricolporites* varia, rugulat
0	0	3	2	2	0	3	0	0	3	0	0	1	2	0	3	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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Tricolporites varia, small	*Tricolporites* varia, big	*Polygonum*	*Gentiana* type	*Globularia* type	Crassulaceae	*Menyanthes* type	*Helleborus* type (elongated trico	*Eucomia* type	Scrophulariaceae type	*Elaeagnus/Slowakipollis*	Ranunculaceae	Saxifragaceae	*Sarcopoterium* type	Rosaceae	*Bupleurum* type	Sapotaceae	*Tetracolporopollenites* (psilate)	Hexacolpate (e.g. "*Pinguicola* ty	Hexacolporate	Cyperaceae	Poaceae	*Acorus*	*Pistillipollenites*	*Nuphar*	Nymphaea	Monogemmites	*Sparganium* type (plus *Typha* ty	*Potamogeton*	*Lemna* type (*Sigmopollis* ?)	*Allium* type	varia (unidentified, possible polle	*Monopunctites*	*Eriphorum* type	plant spores varia	trilete spores	*Saxosporis*	*Osmunda*	*Sphagnum*	*Lycopodium*	*Pteridium*	monolete spores	*Echinatisporis*	*Equisteum*	*Laevigatosorites nudites*	*Cystopteris*	*Polypodium*	*Dryopteris*	fungal remains varia	fungal spores varia	*Brachysporites*	*Pesouisfrag.*	*Polypodiisporites*	*Diporicellaesporites*	*Pleuricallaesporites*	*Cicatricosisporites*
1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	15	2	0	0	0	0	0	0	0	2	15	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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3	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	2	0	0	0	1	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
3	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	7	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

multicell. fungal remains	"striate" fungal spore	*Callimoth. Microthyriacites*	REFERENCE SUM (POLLEN E:	Dinos/nonsaccate Pollen	Forams/nonsaccate Pollen	Pollen Concentration
7	0	2	244	0,00766284	0,00127714	12606,6667
10	0	0	231	0,00401606	0,00401606	11392,5
0	0	1	179	0,01058201	0	7022,90909
0	0	1	237	0,0244898	0	15126,1765
0	1	0	241	0,01568627	0,00522876	14134,3243
0	0	1	275	0,03767123	0,00570776	6498,27947
0	0	0	219	0,07725322	0,01573677	14400,9091
0	0	0	241	0,016	0,004	32036,8782
0	0	0	219	0,05172414	0,00862069	24725,8065
0	0	0	200	0,22857143	0,05873016	86800
0	0	1	236	0,17391304	0,03820817	48496,2121
0	0	0	233	0,11646586	0,01204819	26644,7091
0	0	0	196	0,18483412	0,04581359	21480,8081
0	0	0	241	0,14	0,02	92659,4614
0	0	0	214	0,14473684	0,0628655	21781,4259
0	0	0	226	0,15811966	0,03418803	25942,6576
1	0	0	223	0,08119658	0,05982906	21306,3579
0	0	0	221	0,13157895	0,03070175	26197,4216
0	0	0	241	0,2007874	0,0328084	48244,4649
0	0	0	210	0,08928571	0,04017857	22785
0	0	0	237	0,04743083	0,01317523	22426,7399
0	0	0	205	0,18691589	0,02336449	20594,9074
0	0	2	238	0,064	0,04533333	92225
0	0	0	124	0,20437956	0,02676399	9090,54054
0	0	0	137	0,16083916	0,04428904	4129,02778
0	0	2	218	0,07860262	0,02620087	21301,3329
0	0	0	249	0,22393822	0,02187902	42213,2813
0	0	0	225	0,25	0,01129944	67812,5
1	0	0	226	0,05737705	0,00409836	204341,667
0	0	0	221	0,06808511	0,0141844	299731,25
0	0	0	237	0,05976096	0,00265604	321431,25
0	0	0	226	0,2212766	0,03120567	61302,5
0	0	0	214	0,10666667	0,01777778	38698,3333
2	0	0	221	0,04680851	0,03404255	99910,4167
0	0	0	238	0,15810277	0,01054018	40348,4375
0	0	0	231	0,06639004	0,00829876	89512,5
0	0	1	241	0,12992126	0,02887139	36317,3611
0	0	0	264	0,09964413	0,04270463	19481,7384
1	0	0	205	0,31944444	0,01697531	27803,125
0	0	0	218	0,21551724	0,01149425	#DIV/0!
0	0	0	221	0,19396552	0,10632184	99910,4167
0	0	0	232	0,02	0,016	104883,333
0	0	0	237	0,22047244	0,00524934	27950,5435
0	0	0	238	0,109375	0,04427083	38553,2995

0	0	0	215	0,04366812	0,04075691	12849,7852
0	0	0	220	0,11489362	0,02269504	31826,6667
0	0	0	261	0,2080292	0,04987835	25356,8231
0	0	0	259	0,14492754	0,17391304	9506,91837
0	0	0	231	0,2033195	0,31120332	17449,8287
0	0	0	166	0,29378531	0,37288136	6154,66102
1	0	0	255	0,2754717	0,2490566	30138,8889
0	0	0	228	0,19087137	0,14937759	26040
0	0	0	207	0,26696833	0,07541478	29946
0	0	0	153	0,09876543	0,07201646	13280,4
0	0	0	231	0,06273063	0,02214022	17204,4893
0	0	0	205	0,24778761	0,03244838	74141,6667
0	0	0	188	0,17567568	0,02102102	18543,6364
0	0	0	203	0,17040359	0,09118087	24472,7778
0	0	0	158	0,48108108	0,07567568	15624,3164
1	0	0	212	0,19574468	0,24113475	25833,3333
0	0	0	118	0,22058824	0,34068627	30483,3333