Fig. A

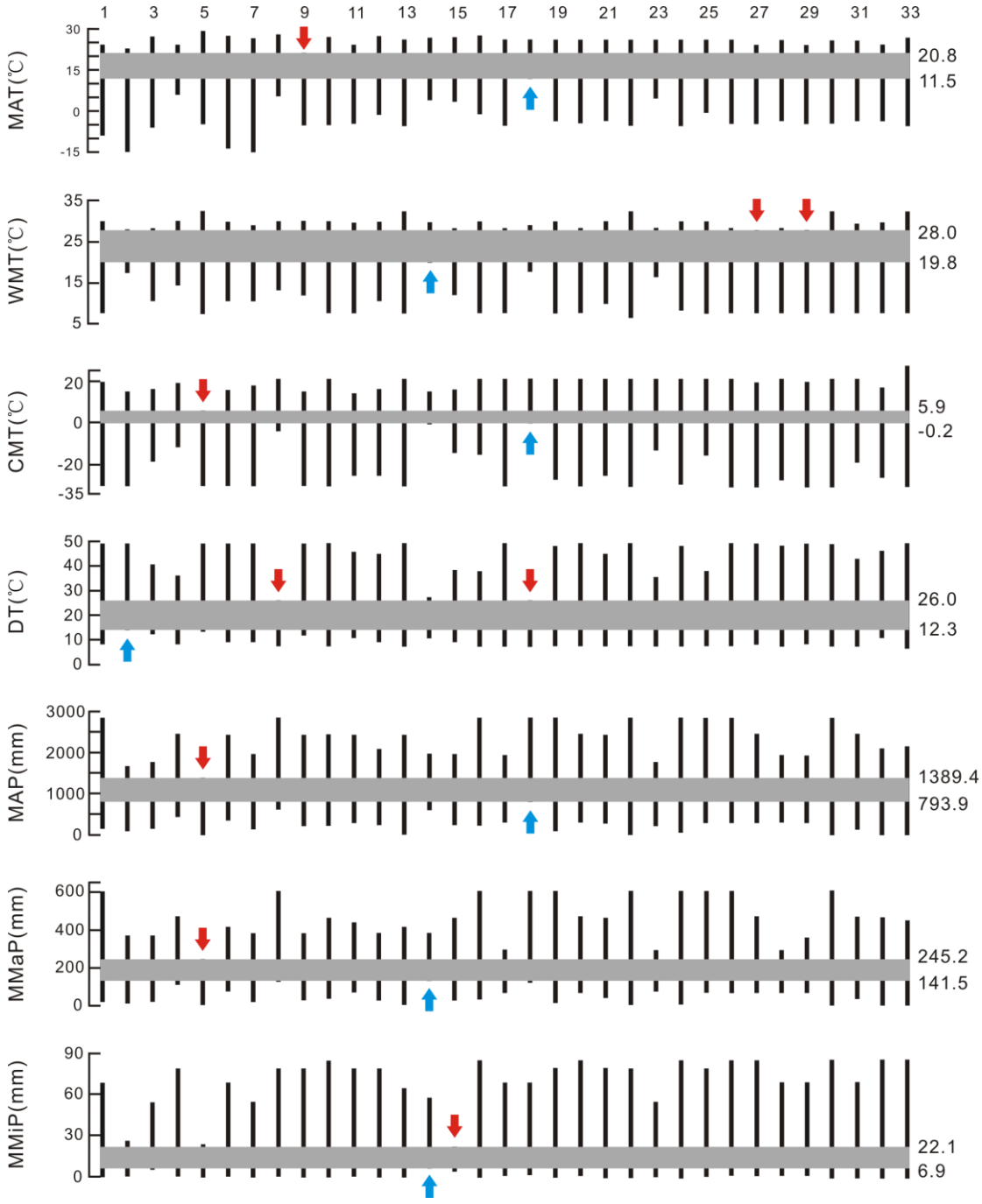

Fig. A Coexistence intervals for all the parameters calculated by the CA.

Table A Palynomorph relative abundance of Wutu whole section and palynological zones.

palynological taxa	Whole section	Zone No.			palynological taxa	Whole section	Zone No.		
		1	2	3			1	2	3
	(%)	(%)	(%)	(%)		(%)	(%)	(%)	(%)
Gymnosperm	**49.51**	**67.38**	**35.22**	**52.68**	*Ulmipollenites*	0.03	/	0.13	/
Pinuspollenites	41.54	55.91	21.50	47.68	*Tiliaepollenites*	0.03	/	0.13	/
Taxodiaceaepollenites	3.14	0.36	8.84	1.20	*Artemisiaepollenites*	0.03	/	0.13	/
Psophosphaera	2.76	7.89	1.58	2.46	Bignoniaceae	0.03	/	0.13	/
Ephedripites	1.71	2.87	3.17	0.93	*Corsinipollenites*	0.03	/	0.13	/
Abiespollenites	0.28	0.36	0.13	0.33	*Lonicerapollis*	0.03	/	0.13	/
Piceapollis	0.03	/	/	0.05	*Tricolporopollenites rosaeformis*	0.03	/	0.13	/
Ginkgoretectina	0.03	/	/	0.05	*Ilexpollenites*	0.03	/	/	0.05
Angiosperm	**48.36**	**30.82**	**60.95**	**45.85**	*Sapindaceidites*	0.03	/	/	0.05
Momipites coryloides	29.89	24.73	35.88	28.21	*Echitricoloorites*	0.03	/	/	0.05
Betulaceoipollenites	7.01	2.15	7.52	7.55	*Umbelliferaepites*	0.03	/	/	0.05
Castanopsis	3.17	1.43	7.65	1.59	*Chenopodipollis*	0.03	/	/	0.05
Tricolporopollenites	2.23	1.43	4.75	1.31	**Pteridopytes**	**1.99**	**1.79**	**3.69**	**1.31**
Alnipollenites	2.09	0.72	1.85	2.41	*Leiotriletes*	1.05	0.72	2.51	0.49
Juglanspollenites	1.08	/	0.13	1.64	*Pteris*	0.24	/	0.13	0.33
Pterocaryapollenites	1.05	/	0.40	1.48	Hemionitidaceae	0.21	0.36	0.40	0.11
Caryapollenites	0.31	0.36	0.13	0.38	Polypodiaceae	0.17	0.36	0.13	0.16
Momipites	0.28	/	0.26	0.33	Loxogrammaceae	0.10	/	/	0.16
Graminidites	0.21	/	0.40	0.16	*Subturma azonomonoletes*	0.07	0.36	0.13	/
Cyperaceaepollis	0.14	/	0.40	0.05	Dennstaedtiaceae	0.03	/	0.13	/
Euphorbiacites	0.10	/	0.26	0.05	Hymenophyllaceae	0.03	/	0.13	/
Palmaepollenites	0.10	/	0.13	0.11	*Selaginella*	0.03	/	0.13	/
Magnolipollis	0.07	/	0.26	/	*Osmunda*	0.03	/	/	0.05
Quercoidites	0.07	/	/	0.11	**Other elements**	**0.14**	**/**	**0.13**	**0.16**
Aceripollenites	0.07	/	/	0.11	Zygnemataceae	0.10	/	0.13	0.11
Potamogetonacidites	0.07	/	/	0.11	Pediastraceae	0.03	/	/	0.05

/, no pollen grain or spore of this taxon exists.

Table B List of the Early Eocene Wutu taxa grouped by ecological requirements and their relative abundance in palynological zones.

Zone No.	1(%)	2(%)	3(%)	Zone No.	1(%)	2(%)	3(%)
Megathermic elements				*Ulmipollenites*	/	0.13	/
Palmaepollenites	/	0.13	0.11	*Lonicerapollis*	/	0.13	/
Sapindaceidites	/	/	0.05	*Tiliaepollenites*	/	0.13	/
Mega-mesothermic elements				**Meso-microthermic elements**			
Taxodiaceaepollenites	0.36	8.84	1.20	*Pinuspollenites*	55.91	21.50	47.68
Castanopsis	1.43	7.65	1.59	**Microthermic elements**			
Magnolipollis	/	0.26	/	*Abiespollenites*	0.36	0.13	0.33
Euphorbiacites	/	0.26	0.05	*Piceapollis*	/	/	0.05
Bignoniaceae	/	0.13	/	**Non-significant elements**			
Mesothermic elements				*Tricolporopollenites rosaeformis*	/	0.13	/
Momipites coryloides	24.73	35.88	28.21	**Herbs and shrubs**			
Betulaceoipollenites	2.15	7.52	7.55	*Ephedripites*	2.87	3.17	0.93
Alnipollenites	0.72	1.85	2.41	*Graminidites*	/	0.40	0.16
Pterocaryapollenites	/	0.40	1.48	*Cyperaceaepollis*	/	0.40	0.05
Caryapollenites	0.36	0.13	0.38	*Potamogetonacidites*	/	/	0.11
Juglanspollenites	/	0.13	1.64	*Corsinipollenites*	/	0.13	/
Momipites	/	0.26	0.33	*Artemisiaepollenites*	/	0.13	/
Quercoidites	/	/	0.11	*Echitricoloorites*	/	/	0.05
Aceripollenites	/	/	0.11	*Umbelliferaepites*	/	/	0.05
Ginkgoretectina	/	/	0.05	*Chenopodipollis*	/	/	0.05
Ilexpollenites	/	/	0.05				

/, no pollen grain or spore of this taxon exists.

Table C The fossil palynomorph taxa used in CA along with their nearest living relatives (NLRs).

Fossil palynomorph taxa	NLRs
Pinuspollenites	*Pinus*
Abiespollenites	*Abies*
Piceapollis	*Picea*
Ephedripites	*Ephedra*
Taxodiaceaepollenites	Taxodiaceae
Ilexpollenites	*Ilex*
Palmaepollenites	Arecaceae
Sapindaceidites	Sapindaceae
Euphorbiacites	Euphorbiaceae
Bignoniaceae	Bignoniaceae
Castanopsis	*Castanopsis*
Magnolipollis	Magnoliaceae
Betulaceoipollenites	*Betula*
Momipites coryloides	*Corylus*
Ulmipollenites	*Ulmus*
Quercoidites	*Quercus*
Alnipollenites	*Alnus*
Caryapollenites	*Carya*
Tiliaepollenites	*Tilia*
Momipites	Juglandaceae
Juglanspollenites	*Juglans*
Pterocaryapollenites	*Pterocarya*
Aceripollenites	Aceraceae
Lonicerapollis	Caprifoliaceae
Tricolporopollenites rosaeformis	Rosaceae
Cyperaceaepollis	Cyperaceae
Echitricoloorites	Asteraceae
Artemisiaepollenites	*Artemisia*
Corsinipollenites	Onagraceae
Potamogetonacidites	Potamogetonaceae
Umbelliferaepites	Umbelliferae
Graminidites	Poaceae
Chenopodipollis	Chenopodiaceae

Table D Comparison between the seven climatic parameters in the Early Eocene of Wutu and the current meteorological data.

	Early Eocene ▲	Present ■
MAT(℃)	16.2	12.3
MWMT(℃)	23.9	25.9
MCMT(℃)	2.9	-3.2
DT(℃)	19.2	29.1
MAP(mm)	1091.7	671.5
MMaP(mm)	193.4	200.0
MMiP(mm)	14.5	7.8

Table E List of fossil localities in East China.

Period	Site	Location	Formation	Site coordinate	References
Late Pliocene	16	Zhangcun	Zhangcun	36.9 °N, 112.8 °E	Qin et al. 2011
Early Pliocene	24	Du'ao		29.3 °N, 121.5 °E	Li et al. 2010
Late Miocene	15	Huanghua		39.5 °N, 117.5 °E	Liu et al. 2010
	17	Jiyang	Minghuazhen (upper)	36.9 °N, 117.2 °E	Liu et al. 2010
	2	Huanan	Daotaiqiao	47 °N, 130 °E	Liu et al. 2010
Mid Miocene	20	Shanwang	Shanwang	36.5 °N, 118.7 °E	Yang et al. 2007
	9	Erlian	Tonggure	43.6 °N, 111.9 °E	Liu et al. 2010
	22	Tianchang	Yancheng	33 °N, 118 °E	Liu et al. 2010
	18	Bozhong	Minghuazhen (lower)	36.9 °N, 119 °E	Liu et al. 2010
	23	Zhoukou	Guantao	33.6 °N, 114.6 °E	Liu et al. 2010
	4	Jidong		45.2 °N, 131 °E	Liu et al. 2010
	2	Huanan	Daodaiqiao	47 °N, 130 °E	Liu et al. 2010
	11	Hunchun	Tumenzi	42.8 °N, 130 °E	Liu et al. 2010
late Early-early Mid Miocene	21	Lantian	Lengshuigou	34 °N, 108 °E	Liu et al. 2010
	21	Lantian	Gaoling	34 °N, 108 °E	Liu et al. 2010
	14	Shangdou		41.3 °N, 113.5 °E	Liu et al. 2010
Early Miocene	12	Weichang		42.1 °N, 117.8 °E	Li et al. 2009
	17	Jiyang	Guantao	36.9 °N, 117.2 °E	Liu et al. 2010
	14	Shangdou		41.3 °N, 113.5 °E	Liu et al. 2010
	8	Dunhua	Qiuligou	43.3 °N, 128.1 °E	Liu et al. 2010
Oligocene	7	Shulan	Shuiquliu	44.5 °N, 126.9 °E	Quan et al. 2012
Late Eocene	13	Fushun	Gengjiajie	41.8 °N, 123.9 °E	Quan et al. 2012
	11	Hunchun	Hunchun (upper)	42.8 °N, 130.3 °E	Quan et al. 2012
Mid Eocene	13	Fushun	Jijuntun	41.8 °N, 123.9 °E	Wang et al. 2010
	13	Fushun	Xilutian	41.8 °N, 123.9 °E	Wang et al. 2010
	10	Huadian	Huadian	42.9 °N, 126.7 °E	Quan et al. 2012
	6	Mudanjiang	Huanghua	44.6 °N, 129.4 °E	Quan et al. 2012
	7	Shulan	Jishu	44.5 °N, 126.9 °E	Quan et al. 2012
	3	Yilan	Dalianhe	46.1 °N, 129.3 °E	Quan et al. 2012
	11	Hunchun	Hunchun (lower)	42.8 °N, 130.3 °E	Quan et al. 2012
Early-Mid Eocene	25	Changchang	Changchang	19.6 °N, 110.4 °E	Yao et al. 2009
Early Eocene	19	Wutu	Wutu	36.6 °N, 118.9 °E	This study
	13	Fushun	Guchengzi	41.8 °N, 123.9 °E	Wang et al. 2010
	7	Shulan	Bangchuigou	44.5 °N, 126.9 °E	Quan et al. 2012
	5	Hualin	Bahuli	44.8 °N, 129.8 °E	Quan et al. 2012
	3	Yilan	Xin'ancun	46.1 °N, 129.3 °E	Quan et al. 2012
Late Paleocene	13	Fushun	Lizigou	41.8 °N, 123.9 °E	Wang et al. 2010
Mid Paleocene	13	Fushun	Laohutai	41.8 °N, 123.9 °E	Wang et al. 2010
	1	Wuyun	Wuyun (upper)	49.3 °N, 129.5 °E	Hao et al. 2010
Early Paleocene	1	Wuyun	Wuyun (lower)	49.3 °N, 129.5 °E	Hao et al. 2010

Table F Comparison of climatic parameters of fossil localities in East China extended from the Early Paleocene to the Late Pliocene.

Period	Location	Formation	MAT	MWMT	MCMT
Late Pliocene	Zhangcun	Zhangcun	8.5-15.1	19.8-27.5	-0.3-2.0
Early Pliocene	Du'ao		18.1-22.0	23.8-25.4	10.7-12.1
Late Miocene	Huanghua		15.7-16.1	24.7-24.9	5-7.1
	Bozhong	Minghuazhen (upper)	11.6-18.4	23-28.2	-0.3-12.5
	Huanan	Daotaiqiao	14-16.1	24.7-25.6	-0.5-7.1
Mid Miocene	Shanwang	Shanwang	10.9-14.5	21.9-25.0	-0.5-3.3
	Erlian	Tonggure	13.3-21.1	24-28.3	-0.1-13.3
	Tianchang	Yancheng	15.7-16.1	23-25.6	3.8-7.8
	Bozhong	Minghuazhen (lower)	13.6-18.4	23.6-28.2	1.8-12.5
	Zhoukou	Guantao	12.5-16.1	24.9-25.6	1.7-7.1
	Jidong		11.5-15.8	23.0-25.6	1.7-5.6
	Huanan	Daodaiqiao	14-16.1	24.7-25.6	-0.5-6.2
	Hunchun	Tumenzi	16.5	27.3-27.4	5.5-7.1
late Early-early Mid Miocene	Lantian	Lengshuigou	15.7-20.8	21.7-28.1	3.8-13.3
	Lantian	Gaoling	16.8-18.4	23-28.1	10.6-12.5
	Shangdou		13.9-19.2	25.7-28.1	2.2-13.3
Early Miocene	Weichang	Hannuoba	7.8-14.9	23.5-25.4	-3.0-5.9
	Jiyang	Guantao	11.5-20.8	23.0-28.1	-1.0-13.3
	Shangdou		11.5-20.8	23.0-28.1	1.7-13.3
	Dunhua	Qiuligou	15.7-20.8	28.0-28.1	5.5-13.3
Oligocene	Shulan	Shuiquliu	11.6-16.1	22.8-25.6	-0.1-7.8
Late Eocene	Fushun	Gengjiajie	17.9-18.4	27.3-28.1	7.0-12.5
	Hunchun	Hunchun (upper)	17.9-18.4	27.3-28.1	7.0-12.5
Mid Eocene	Fushun	Jijuntun	14.8-20.9	19.4-24.7	9.1-12.6
	Fushun	Xilutian	11.5-20.9	22.5-26.6	3.6-12.6
	Huadian	Huadian	15.6-18.4	24.7-27.9	3.8-12.5
	Mudanjiang	Huanghua	17.9-18.3	24.7-27.7	7.0-10.2
	Shulan	Jishu	15.6-18.4	24.7-25.0	7.0-7.8
	Yilan	Dalianhe	13.3-20.8	24.7-27.9	2.2-12.5
	Hunchun	Hunchun (lower)	16.5-18.4	27.3-27.9	6.6-7.8
Early-Mid Eocene	Changchang	Changchang	14.2-19.8	22.5-29.1	1.7-11.9
Early Eocene	Wutu	Wutu	11.5-20.8	19.8-28.0	-0.2-5.9
	Fushun	Guchengzi	14.8-21.0	19.4-24.7	9.1-13.9
	Shulan	Bangchuigou	15.2-18.4	24.0-27.9	6.6-12.5
	Hualin	Bahuli	13.6-18.4	23.6-28.1	3.7-12.5
	Yilan	Xin'ancun	17.9-18.4	27.3-27.9	7.0-12.5
Late Paleocene	Fushun	Lizigou	11.3-20.9	23.9-27.5	3.6-12.6
Mid Paleocene	Fushun	Laohutai	11.5-20.9	22.5-28.2	3.6-12.6
	Wuyun	Wuyun (upper)	14.8-16.6	23.9-28.3	3.6-3.6
Early Paleocene	Wuyun	Wuyun (lower)	14.8-16.6	22.5-28.3	3.6-3.6

Table G After considering the latitudinal temperature gradient (correction to 44.5 °N), comparison of climatic parameters of all the fossil localities.

Period	Location	Formation	MAT	MWMT	MCMT
Late Pliocene	Zhangcun	Zhangcun	4.3-10.9	15.6-23.3	-4.5--2.2
Early Pliocene	Du'ao		9.7-13.6	15.4-17.0	2.3-3.7
Late Miocene	Huanghua		13.4-13.8	22.4-22.6	2.7-4.8
	Bozhong	Minghuazhen (upper)	8.2-15.0	19.6-24.8	-3.7-9.1
	Huanan	Daotaiqiao	15.1-17.2	25.8-26.7	0.6-8.2
Mid Miocene	Shanwang	Shanwang	7.3-10.9	18.3-21.4	-4.1--0.3
	Erlian	Tonggure	12.9-20.7	23.6-27.9	-0.5-12.9
	Tianchang	Yancheng	10.5-10.9	17.8-20.4	-1.4-2.6
	Bozhong	Minghuazhen (lower)	10.2-15.0	20.2-24.8	-1.6-9.1
	Zhoukou	Guantao	7.6-11.2	20.0-20.7	-3.2-2.2
	Jidong		11.8-16.1	23.3-25.9	2.0-5.9
	Huanan	Daodaiqiao	15.1-17.2	25.8-26.7	0.6-7.3
	Hunchun	Tumenzi	15.7	26.5-26.6	4.7-6.3
late Early-early Mid Miocene	Lantian	Lengshuigou	11.0-16.1	17.0-23.4	-0.9-8.6
	Lantian	Gaoling	12.1-13.7	18.3-23.4	5.9-7.8
	Shangdou		12.5-17.8	24.3-26.7	0.8-11.9
Early Miocene	Weichang	Hannuoba	6.7-13.8	22.4-24.3	-4.1-4.8
	Jiyang	Guantao	8.1-17.4	19.6-24.7	-4.4-9.9
	Shangdou		10.1-19.4	21.6-26.7	0.3-11.9
	Dunhua	Qiuligou	15.2-20.3	27.5-27.6	5.0-12.8
Oligocene	Shulan	Shuiquliu	11.6-16.1	22.8-25.6	-0.1-7.8
Late Eocene	Fushun	Gengjiajie	17.6-18.1	27.0-27.8	6.7-12.2
	Hunchun	Hunchun (upper)	17.7-18.2	27.1-27.9	6.8-12.3
Mid Eocene	Fushun	Jijuntun	14.5-20.6	19.1-24.4	8.8-12.3
	Fushun	Xilutian	11.2-20.6	22.2-26.3	3.3-12.3
	Huadian	Huadian	15.4-18.2	24.5-27.7	3.6-12.3
	Mudanjiang	Huanghua	17.9-18.3	24.7-27.7	7.0-10.2
	Shulan	Jishu	15.6-18.4	24.7-25.0	7.0-7.8
	Yilan	Dalianhe	13.5-21.0	24.9-28.1	2.4-12.7
	Hunchun	Hunchun (lower)	16.3-18.2	27.1-27.7	6.4-7.6
Early-Mid Eocene	Changchang	Changchang	11.7-17.3	20.0-26.6	-0.8-9.4
Early Eocene	Wutu	Wutu	10.7-20.0	19.0-27.2	-1.0-5.1
	Fushun	Guchengzi	14.5-20.7	19.1-24.4	8.8-13.6
	Shulan	Bangchuigou	15.2-18.4	24.0-27.9	6.6-12.5
	Hualin	Bahuli	13.6-18.4	23.6-28.1	3.7-12.5
	Yilan	Xin'ancun	18.1-18.6	27.5-28.1	7.2-12.7
Late Paleocene	Fushun	Lizigou	10.7-20.3	23.3-26.9	3.0-12.0
Mid Paleocene	Fushun	Laohutai	10.9-20.3	21.9-27.6	3.0-12.0
	Wuyun	Wuyun (upper)	16.0-17.8	25.1-29.5	4.8-4.8
Early Paleocene	Wuyun	Wuyun (lower)	16.0-17.8	23.7-29.5	4.8-4.8

Table H The Cenozoic temperature evolution of East China.

Period	MAT min-max (mid)	MWMT min-max (mid)	MCMT min-max (mid)
Late Pliocene	4.3-10.9 (7.6)	15.6-23.3 (19.5)	-4.5--2.2 (-3.4)
Early Pliocene	9.7-13.6 (11.7)	15.4-17.0 (16.2)	2.3-3.7 (3.0)
Late Miocene	8.2-17.2 (12.7)	19.6-26.7 (23.2)	-3.7-9.1 (2.7)
Mid Miocene	7.3-20.7 (14.0)	17.8-27.9 (22.9)	-4.1-12.9 (4.4)
late Early-early Mid Miocene	11.0-17.8 (14.8)	17.0-26.7 (21.9)	-0.9-11.9 (5.5)
Early Miocene	6.7-20.3 (13.5)	19.6-27.6 (23.6)	-4.4-12.8 (4.2)
Oligocene	11.6-16.1 (13.9)	22.8-25.6 (24.2)	-0.1-7.8 (3.9)
Late Eocene	17.6-18.2 (17.9)	27.0-27.9 (27.5)	6.7-12.3 (9.5)
Mid Eocene	11.2-21.0 (16.1)	19.1-28.1 (23.6)	2.4-12.7 (7.6)
Early-Mid Eocene	11.7-17.3 (14.5)	20.0-26.6 (23.3)	-0.8-9.4 (4.3)
Early Eocene	10.7-20.7 (15.7)	19.0-28.1 (23.6)	-1.0-13.6 (6.3)
Late Paleocene	10.7-20.3 (15.5)	23.3-26.9 (25.1)	3.0-12.0 (7.5)
Mid Paleocene	10.9-20.3 (15.6)	21.9-29.5 (25.7)	3.4-12.0 (7.7)
Early Paleocene	16.0-17.8 (16.9)	23.7-29.5 (26.6)	4.8-4.8 (4.8)