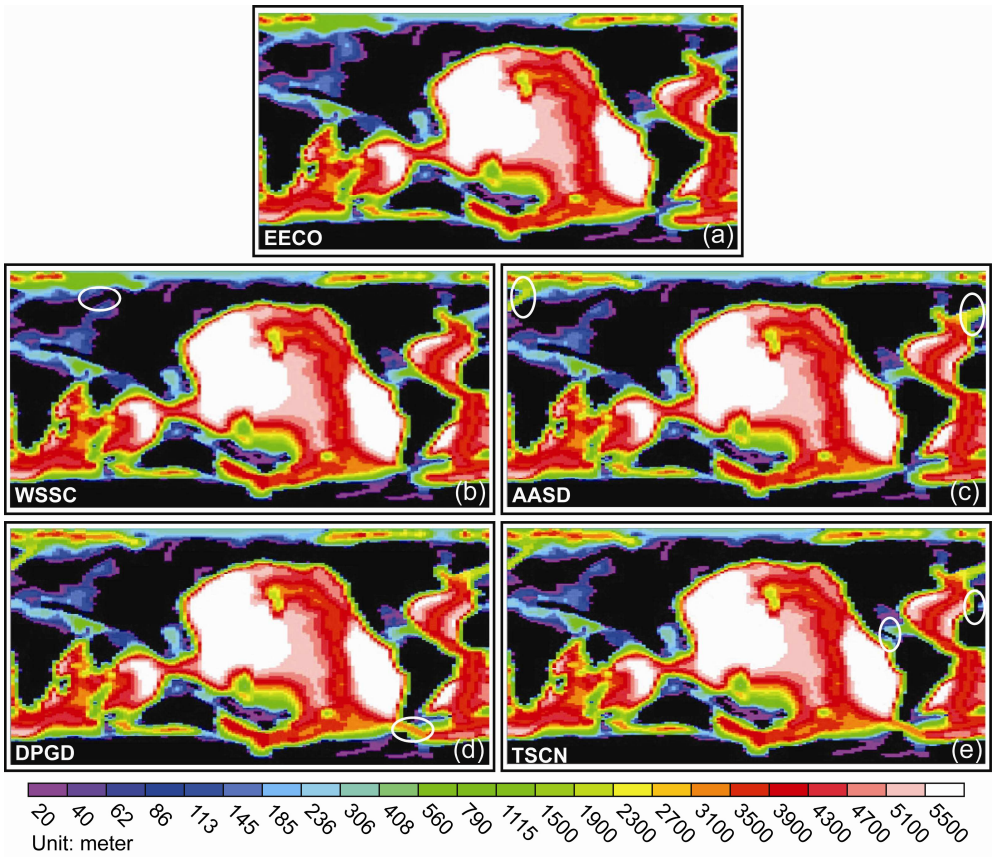
Supplementary Materials

There are two parts to the supplementary materials, 1 figures and 1 list of geological data and references. The figure shows the reconstructed bathymetry used in the Early Eocene (EECO) experiment as well as changes applied in the four sensitivity experiments: WSSC (closing of the West Siberian Seaway); AASD (deepening of the Arctic/Arctic-Atlantic Seaway); DPGD (deepening of the Drake Passage Gateway) and TSCN (constriction of the tropical Atlantic seaways). Finally we list geological evidence and references used in Figure 1.

Supplementary Materials I: Paleobathymetry used in FOAM experiments



Paleobathymetry used in the FOAM experiments for (a) the Early Eocene experiment and (b to e) the four sensitivity experiments. The white circles highlight the seaways that are changed. The colour bars follow the depth levels of Slarti, a boundary condition generator for FOAM.

Supplementary Materials II: Geological evidence and references used in Figure1

Supplementary Table 1. Early Eocene surface temperature estimations used in Figure 1d.

Site[1]	PLat[2]	Mean[3]	Range[3]	Method	Reference
SST					
21	-31	24		d18O	Zachos et al., 1994
20C	-30	20		d18O	Zachos et al., 1994
94	-88	22		d18O	Zachos et al., 1994
144	7	26		d18O	Zachos et al., 1994
171	10	25		d18O	Zachos et al., 1994
213	-32	18		d18O	Zachos et al., 1994
215	-34	19		d18O	Zachos et al., 1994
237	-16	24		d18O	Zachos et al., 1994
356	-31	23		d18O	Zachos et al., 1994
357	-32	23		d18O	Zachos et al., 1994
525	-35	17		d18O	Zachos et al., 1994
527	-34	17		d18O	Zachos et al., 1994
528	-35		15-17	d18O	Zachos et al., 1994
548	45		13-23	d18O	Zachos et al., 1994
577	24	20		d18O	Zachos et al., 1994
690	-65		11-14	d18O	Zachos et al., 1994
702	-53		12-16	d18O	Zachos et al., 1994
738	-63		11-15	d18O	Zachos et al., 1994
747	-56	14		d18O	Zachos et al., 1994
748	-60	16		d18O	Zachos et al., 1994
757	-43		13-17	d18O	Zachos et al., 1994
865B	9		20-25	d18O	Bralower et al., 1995
Ameke	-5		29-31	d18O	Andreasson and Schmitz, 1998
Tanzania	-15		29-32	d18O	Pearson et al., 2007
Seymour Island	-70		5-15	d18O	Ivany et al., 2008
New Zeland	-55		24-32	d18O	Creech et al., 2010
865B	9		31-34	Mg/Ca	Tripati et al., 2003
865B	9		26-28	Mg/Ca	Tripati et al., 2003
527	-34		29-32	Mg/Ca	Tripati et al., 2004
527	-34		24-27	Mg/Ca	Tripati et al., 2004
New Zeland	-55	29		Mg/Ca	Hollis et al., 2009
New Zeland	-55		24-30	Mg/Ca	Creech et al., 2010
IODP302	83		12-23	TEX86	Sluijs et al., 2006
IODP302	83		9-12	TEX86	Brinkhuis et al., 2006
New Jersey	40		30-35	TEX86	Sluijs et al., 2007
Tanzania	-15		35-40	TEX86	Pearson et al., 2007
New Zeland	-55		30-31	TEX86	Hollis et al., 2009, Creech et al., 2010
ODP1172	-65		28-35	TEX86	Bijl et al., 2009
Estimations from land					
Wyoming	45		17-23	LMA	Wing et al., 2000

Wyoming	45	18		LMA	Wing et al., 2005
McAbee	51		7-16	LMA	Fricke and Wing, 2004
Bear's Paw	49		8-18	LMA	Fricke and Wing, 2004
Camel's Butte	47		5-15	LMA	Fricke and Wing, 2004
Yellowstone	45		7-17	LMA	Fricke and Wing, 2004
Kisinger Lake	44		16-26	LMA	Fricke and Wing, 2004
Upper Willwood	44		20-31	LMA	Fricke and Wing, 2004
Lower Willwood	44		16-26	LMA	Fricke and Wing, 2004
Wind River	44		16-27	LMA	Fricke and Wing, 2004
Sourdough	42		19-30	LMA	Fricke and Wing, 2004
Niland	42		19-32	LMA	Fricke and Wing, 2004
Little Mtn.	41		17-28	LMA	Fricke and Wing, 2004
Sourdough	42		12-24	LMA	Fricke and Wing, 2004
Chalk Bluffs	40		15-24	LMA	Fricke and Wing, 2004
Okanagan	50		10-15	LMA	Greenwood et al. 2005
Brandy Ck	-59		18-25	LMA	Greenwood et al., 2003, 2004
Hotham Heights	-59		17-25	LMA	Greenwood et al., 2003, 2004
Hatchetlgbee Bluff	33	31		d18O	Ivany et al., 2004
Wyoming	45	26		d18O	Fricke and Wing, 2004
Big Bene	29	32		d18O	Fricke and Wing, 2004
San Juan	36	28		d18O	Fricke and Wing, 2004
Green River	44	16		d18O	Fricke and Wing, 2004
Bignorn Basin	45		18-25	d18O	Fricke and Wing, 2004
Powder River	45	19		d18O	Fricke and Wing, 2004
Ellesmere Island	73	4		d18O	Fricke and Wing, 2004
High Arctic	79		9-12	d18O	Eberle et al., 2006
High Arctic	79	8		d18O	Eberle et al., 2010
Norwegian–Greenland	70		13-15	Bioclimatic analysis	Eldrett et al., 2009
Ellesmere Island	71	14		Crocodile remains	Markwich, 1998
Antarctica	-70	15		Clay mineral	Robert and Kennett, 1994

LMA: Leaf-Margin analysis

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Oxygen and carbon isotope data

Supplementary Table 2. Early Eocene Oxygen isotope data used in Figure 1e.

Site[1]	PLat[2]	Mean[3]	Stdvar[3]	N[3]	Reference
690	-65.32	-0.3347	0.2502	43	Kennett and Stott, 1990
689	-64.71	0.0019	0.3153	5	Kennett and Stott, 1990
738	-63.86	-0.4870	0.2080	14	Barrera and Huber, 1991
699	-53.96	-0.8496	0.4716	7	Katz and Miller, 1991
700	-53.94	-0.6543	0.2087	14	Katz and Miller, 1991
698	-53.91	-0.6032	0.1812	10	Katz and Miller, 1991
702	-53.28	-0.3725	0.3302	17	Katz and Miller, 1991
757 M	-43.4	0.1147	0.2710	17	Zachos et al., 2001; Veizer et al., 1999
525	-35.29	0.2197	0.1052	7	Shackleton et al., 1984
525 M	-35.29	0.1450	0.3530	16	Shackleton et al., 1984
528 M	-34.66	0.1750	0.4172	2	Shackleton et al., 1984
215 M	-34.5	-0.2300	0.2935	5	Zachos et al., 2001; Veizer et al., 1999
527	-34.10	0.3010	0.2035	7	Shackleton et al., 1984
527 M	-34.10	0.3943	0.1827	7	Shackleton et al., 1984
213 M	-31.8	0.0600	0.2762	10	Zachos et al., 2001; Veizer et al., 1999
1220	2.13	-0.4044	0.2556	84	Nunes and Norris, 2005
1221	3.90	0.1078	0.2897	93	Nunes and Norris, 2005
1257-1260 M	6.79	-0.9500	0.2121	2	Bice and Norris, 2005
865	9.09	0.0895	0.2331	21	Zachos et al., 2001; Veizer et al., 1999
577	39.02	-0.6366	0.4456	26	Pak and Miller, 1992
883	42.21	-0.5666	0.4244	21	Pak and Miller, 1995
884	42.43	0.2045	0.3382	10	Pak and Miller, 1995
401	43.26	-0.6235	0.4370	34	Pak and Miller, 1992
550	44.39	-0.6923	0.3799	101	Stella and Birger, 1996
548	44.77	-0.9743	0.4001	7	Poag et al., 1985
Demark	60.84	-2.1010	0.4271	81	Schmitz et al., 1996

1. The mixed benthic foraminiferal $\delta^{18}O$ values are marked with M. Others are corrected to *Cibicidoides* spices according to Katz et al., (2003).
2. Paleolatitude is calculated according to Scotese (2001)
3. Mean values of Early Eocene $\delta^{18}O$ samples. Stdvar is standard variation. N is sample number.

Supplementary Table 3. Early Eocene Carbon isotope data used in the Figure 1f.

Site[1]	PLat[2]	Mean[3]	Stdvar[3]	N[3]	Reference
690	-65.32	0.8251	0.3509	43	Kennett and Stott, 1990
689	-64.71	1.0780	0.3463	5	Kennett and Stott, 1990
738	-63.86	0.7264	0.4134	14	Barrera and Huber, 1991
699	-53.96	1.0223	0.3491	7	Katz and Miller, 1991
700	-53.94	0.7141	0.3932	14	Katz and Miller, 1991
698	-53.91	0.6593	0.2846	10	Katz and Miller, 1991
702	-53.28	0.8146	0.2428	17	Katz and Miller, 1991
525	-35.29	0.8771	0.3767	7	Shackleton et al., 1984
525 M	-35.29	0.6863	0.3192	16	Shackleton et al., 1984
528 M	-34.66	1.0200	0.0141	2	Shackleton et al., 1984
527	-34.10	0.9000	0.2462	7	Shackleton et al., 1984
527 M	-34.10	0.5971	0.2616	7	Shackleton et al., 1984
1220	2.13	0.4882	0.5395	84	Nunes and Norris, 2005
1221	3.90	0.8720	0.4059	93	Nunes and Norris, 2005
1257-1260 M	6.79	0.2000	0.2828	2	Bice and Norris, 2005
865	9.09	0.6670	0.5729	21	Bralower et al., 1995
577	39.02	0.6800	0.4231	26	Pak and Miller, 1992
883	42.21	0.5343	0.2992	21	Pak and Miller, 1995
884	42.43	0.3920	0.1524	10	Pak and Miller, 1995
401	43.26	0.6368	0.3488	34	Pak and Miller, 1992
550	44.39	0.3744	0.4029	101	Stella and Birger, 1996
548	44.77	0.5243	0.5796	7	Poag et al., 1985
Denmark	60.84	-0.1964	0.2614	81	Schmitz et al., 1996

1. The mixed benthic foraminiferal $\delta^{13}C$ values are marked with M. Others are corrected to *Cibicidoides* spices according to Katz et al., (2003).
2. Paleolatitude is calculated according to Scotese (2001)
3. Mean values of Early Eocene $\delta^{13}C$ samples. Stdvar is standard variation. N is sample number.

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