APPENDIX DR1: Methods and Laboratory Techniques

Sediment cores were recovered with a gravity corer from locations identified with an acoustic sub-bottom profiler system. The whole cores were cut into ≤1-metre long sections onboard RV *Polarstern*, logged at 1-cm intervals for P-wave velocity, volume-specific magnetic susceptibility [κ] and wet-bulk density using a GEOTEK multi-sensor core logger and stored at +4°C. The core sections were split at the Alfred Wegener Institute for Polar and Marine Research (Bremerhaven, Germany) and shear strength was measured with a shear vane. Lithology, color and sedimentary structures of the split cores were described visually, and using smear-slides and X-radiographs of 1 cm-thick sediment slabs taken parallel to the core axis. Water contents were determined by weighing samples of 10 cm^3 volume before and after freeze drying. Grain-size composition was analysed on samples of ~60 cm^3 volume by wet- and dry sieving over >63 µm and 2 mm, respectively. For AMS ^{14}C dating, ~10 mg of calcareous microfossils were picked under a microscope from the >63 µm fraction of the sediment samples. At site PS75/214 calcareous material of samples taken from 480 and 497 cmbsf and at site PS75/160 carbonate of samples taken from 490 and 500 cmbsf and from 588 and 600 cmbsf, respectively, had to be combined to retrieve enough material for AMS ^{14}C dating (Table DR1). AMS ^{14}C dates for this study were analysed at the NERC Radiocarbon Laboratory Environment in East Kilbride, UK (pre-fix "SUERC-"), and BETA Analytic Inc., Miami, Florida, U.S.A. (pre-fix "Beta-"), respectively (see Table DR1).

Undisturbed seabed surface sediments from the ASE shelf were collected with (giant) box corers for establishing the regional marine reservoir effect (Table DR1). A coral found on top of gravity core PS75/235 was dated for the same purpose. Most uncorrected ^{14}C-dates of these samples range from 1,144 ± 37 to 1,549 ± 35 yr B.P., which is in agreement with the pre-bomb Antarctic marine reservoir effect (Berkman and Forman, 1996). The slightly higher surface age of 2,845 ± 37 yr B.P. from site PS69/255 probably results from current-induced winnowing and condensed sedimentation as observed in other outer shelf areas around Antarctica (e.g., Smith et al., 2011; Hauck et al., 2012), while the older core-top age of 2,340 ± 40 yr B,P, at site PS75/160 may result from iceberg scouring or partial surface sediment loss by gravity coring. Because we had to date mainly mixed calcareous microfossils, we corrected the down-core ^{14}C-dates with a marine reservoir effect of

1,100 ± 200 yr, which is consistent with both the youngest seafloor surface age from the ASE at site PS69/251 and ^{14}C-age variations determined on different calcareous organisms from a seafloor surface sediment sample from the West Antarctic shelf (Domack et al., 2005). If not stated otherwise, we report all ages given in the text and Figure 2 as calibrated kiloyears before present (kyr B.P.).

For data presented in this study, detailed core descriptions and X-radiographs of cores PS75/160, PS75/167, PS75/214 and PS75/129, see doi.pangaea.de/10.1594/PANGAEA.751493.

Table DR1: Locations, conventional and calibrated AMS ^{14}C dates on calcareous microfossils from the investigated and previously published sediment cores from the ASE. Sample depths are given in centimeters below seafloor (cmbsf; top of CC: sample was taken from top of core catcher, corresponding to 652 cmbsf). All ^{14}C-dates were corrected using an offset (ΔR) of 700 ± 200 yr from the global marine reservoir effect (R) of 400 yr in accordance with both uncorrected ^{14}C-dates of seafloor surface sediments from the ASE (see conventional ^{14}C-ages given in italics) and previous studies from around Antarctica (e.g., Berkman and Forman, 1996; Anderson et al., 2002; Lowe and Anderson, 2002; Domack et al., 2005; Hillenbrand et al., 2010; Smith et al., 2011; Kirshner et al., 2012; Livingstone et al., 2012). The corrected ^{14}C-dates were calibrated with the CALIB Radiocarbon Calibration Program version 6.1.0html (http://calib.qub.ac.uk/calib/) using the MARINE09 calibration dataset. Errors of calibrated dates are given as a 2σ range. The ^{14}C dates marking minimum ages for grounded ice-sheet retreat are highlighted in bold (at each core site the oldest age was used). Minimum age of grounding-line retreat from site PS69/275 is mainly based on the correlation of the relative palaeomagnetic intensity (RPI) record of this core and nearby sediment cores with independently dated global reference curves (Hillenbrand et a., 2010) (we assume an error of ±1,000 yr for this datum).
Coring devices: BC—box core, GBC—giant box core, GC—gravity core, VC—vibro core, TC—trigger core, PC—piston core.
Dated calcareous microfossils: bF—benthic foraminifera, Bp—brachiopods, Bv—bivalves, Bz—bryozoans, C—corals, E—echinoid spines, F—mixed benthic and planktonic foraminifera, O— ostracods, P— pteropods, pF—planktonic foraminifera, S—unspecified calcareous shell fragments.
References: A: Smith et al., 2011; B: Hillenbrand et al., 2010; C: Anderson et al., 2002.

Table DR1

Area	Cruise	Gear	Core ID	Latitude (°)	Longitude (°)	Water depth (m)	Distance from grounding line (km)	Core recovery (m)	Sample depth (cmbsf)	Laboratory code	Dated material	Conventional ^{14}C age ±error (yrs BP)	R (yrs)	ΔR ±error (yrs)	Calibrated ^{14}C age ±error (cal yrs BP)	Retreat rate (m/yrs)	Reference
Pine Island Trough (outer shelf)	JR141	BC	448	-71.4683	-108.3589	488		0.12	0.5	SUERC-18333	pF	*1428±37*	*400*	*700±200*	*316±315*		this study
Pine Island Trough (outer shelf)	JR141	BC	451	-71.8656	-106.0408	568		0.24	0.5	SUERC-18938	pF	*1549±35*	*400*	*700±200*	*414±364*		this study
Pine Island Trough (outer shelf)	ANT-XXIII/4	GBC	PS69/255-3	-71.4783	-104.2167	654		0.33	0.5	SUERC-18943	pF	*2845±37*	*400*	*700±200*	*1754±464*		this study
Pine Island Trough (outer shelf)	ANT-XXIII/4	GBC	PS69/251-1	-72.0685	-104.4831	573		0.38	0.5	SUERC-18942	pF	*1144±37*	*400*	*N/A*	*[0]*		this study
Pine Island Trough (middle shelf)	ANT-XXVI/3	GC	PS75/235-1	-72.6658	-107.1655	752		0.40	core top	Beta-284613	C	*1460±40*	*400*	*700±200*	*329±328*		this study
Pine Island Trough (inner shelf)	ANT-XXVI/3	GBC	PS75/215-1	-74.5917	-104.0420	556		0.62	core top	Beta-315966	Bz	*1190±30*	*400*	*700±200*	*232±231*		this study
Pine Island Bay (inner shelf)	ANT-XXVI/3	GC	PS75/214-1	-74.5327	-102.6213	641	111.7	7.72	240	Beta-300843	F, O	8830±40	400	700±200	8680±497		this study
									280	Beta-300844	F, O	8540±40	400	700±200	8354±458		this study
									400	Beta-300845	F, O	8580±40	400	700±200	8410±476		this study
									480+497	Beta-300846	F	**11090±50**	400	700±200	**11664±653**	9.6±0.5	this study
									578	Beta-300847	bF, Bv	8280±40	400	700±200	8034±403		this study
Pine Island Bay (inner shelf)	ANT-XXVI/3	GC	PS75/160-1	-74.5638	-102.6240	337	109.5	6.68	0.5	Beta-284601	bF, S, O	*2340±40*	*400*	*700±200*	*1188±431*		this study
									133.5	Beta-284602	S	2750±40	400	700±200	1665±455		this study
									230	Beta-284604	bF, S, O	4990±40	400	700±200	4381±540		this study
									300	Beta-284681	bF, S	7180±40	400	700±200	6959±443		this study
									380	Beta-284606	bF, S	8410±40	400	700±200	8166±430		this study
									490+500	Beta-284607	bF, P, S, O	**9320±40**	400	700±200	**9196±544**	11.9±0.7	this study
									588+600	Beta-284608	bF, S, O, Bp	8560±40	400	700±200	8391±475		this study
									652	Beta-284610	S	8200±40	400	700±200	7970±391		this study
									top of CC	Beta-284600	Bp, S, bF	8240±40	400	700±200	7999±395		this study
Pine Island Bay (inner shelf)	ANT-XXVI/3	GC	PS75/167-1	-74.6228	-105.8018	526	92.6	9.34	230	Beta-300838	F	8490±40	400	700±200	8283±460		this study
									250	Beta-300839	F, S	8740±40	400	700±200	8564±490		this study
									280	Beta-284682	F	9080±50	400	700±200	8945±492		this study
									401	Beta-284683	F, S, O	9210±50	400	700±200	9048±499		this study
									478	Beta-300837	F, O, E	9180±40	400	700±200	9034±486		this study
									598	Beta-300840	F	9490±40	400	700±200	9529±544		this study
									625.5	Beta-284684	F	9660±50	400	700±200	9707±507		this study
									649	Beta-300841	F	9280±40	400	700±200	9142±524		this study
									670	Beta-284685	F	9450±50	400	700±200	9479±560		this study
									746	Beta-284686	F, S	9690±50	400	700±200	9735±498		this study
									830	Beta-300842	F	9620±50	400	700±200	9656±517		this study
									900.5	Beta-284687	F, S	**10210±60**	400	700±200	**10348±591**	9.0±0.5	this study
Dotson Ice Shelf	JR141	VC	419	-74.1416	-112.8564	806	79.2	4.79	383-384	SUERC-14120	bF	**11237±40**	400	700±200	**11786±603**	6.7±0.3	ref. A
Getz B Ice Shelf	ANT-XXIII/4	GC	PS69/275-1	-73.8888	-117.5483	1518	139.3	4.89	232	N/A	RPI	N/A	400	N/A	**13000±1000**	10.8±0.8	ref. B
Getz D Ice Shelf	NBP99-02	TC	22	-73.7720	-127.8570	719	143.0	6.55	46	AA-40392	S	**13576±74**	400	700±200	**14551±703**	9.9±0.5	ref. C
Getz D Ice Shelf	NBP99-02	PC	23	-73.7750	-127.8570	726	142.7	12.15	2	AA-40390	S	12804±82	400	700±200	13568±424		ref. C
		TC						0.45	23	AA-40267	Bz, S	**13873±86**	400	700±200	**15262±1072**	9.4±0.7	ref. C
		TC							36	AA-40268	Bz, S	13514±85	400	700±200	14509±685		ref. C
Getz D Ice Shelf	NBP99-02	PC	26	-74.2560	-128.3740	468	56.9	0.55	4	AA-40391	F	7949±51	400	700±200	7756±392		ref. C
		PC							19	AA-40393	Bz, S	1848±40	400	700±200	758±386		ref. C
		PC							36	AA-40389	S	11817±69	400	700±200	12558±544		ref. C
		PC							58	AA-40266	S	**14194±82**	400	700±200	**15892±817**	3.6±0.2	ref. C
Getz F Ice Shelf	ANT-XXVI/3	GC	PS75/129-1	-74.5090	-134.1208	923	44.5	2.58	218-220	Beta-284598	Bz, S	**12190±60**	400	700±200	**12967±368**	3.4±0.1	this study