Supplemental Table 1: Seismic surveys used in study

Survey	Type	Source	Fold	Processing	Number of Lines	Year	Length (km)
ATC82B	MCS	35.54 L Bolt-type airgun array	48	Conventional 24-fold, full-trace AGC, vertical stack 2:1	7	1982	1790
BG80	MCS	23.45 L Tuned “U” 24 airgun array	24	Predictive deconvolution, 24-fold stack, adaptive deconvolution, full-trace AGC	26	1980	6742
IT88	MCS	45.16 L airgun array	24	FK filtering, deconvolution before stack, deconvolution after stack	6	1988	2324
IT89RS	MCS	45.16 L airgun array	30	Reformat, trace sum, resample, amplitude recovery gather, deconvolution, NMO, mute, stack, decimation, balance	24	1989	4131
IT90RS	MCS	22.5 L airgun array	60	Reformat, trace sum, resample, amplitude recovery gather, deconvolution, NMO, mute, stack, decimation, balance	31	1990	640
IT94	MCS	71.5 L airgun array	30/ 3	Reformat, trace sum, resample, amplitude recovery gather, deconvolution, NMO, mute, stack, decimation, balance	5	1994	852 (30 fold) 673 (3 fold)
L284AN	MCS	21.5 L airgun array	24	Demultiplex, gain recovery, velocity analysis, normal moveout, filter and post-stack gain, display	19	1984	2405
NBP9601	MCS				50	1996	1206
NBP0301	MCS				40	2003	2093
NBP0301A	SCS				46	2003	1480
NBP0306	MCS				41	2003	1217
NBP0401	MCS				65	2004	2839
NBP0701	MCS				25	2007	2657

NBP0802	SCS				7	2008	525
NBP1502	MCS				4	2015	2109
PD90	SCS				53	1990	5545
SEV87	MCS	10.0 L bolt-type airgun	24	Conventional 24-Fold, vertical stack 2:1, full-trace AGC	15	1987	4439
SEV89	MCS	7.5 L bolt-type airgun	48	Conventional 24-Fold, vertical stack 2:1, full-trace AGC	11	1989	3160
TH82	MCS	9.2 L bolt-type airgun	6	Conventional 6-Fold, full-trace AGC, vertical stack 4:1	8	1982	1495
TH91	MCS	13.11 L water gun array	6	Demultiplex, processing sample interval, time zero adjustment, band pass filter, noise trace edit, CDP sort, spherical divergence compensation, AGC, deconvolution, velocity analysis, normal moveout, CDP stack, post stack deconvolution, time variant band pass filter, datum correction, trace balance, two trace mixing, trace scaling	11	1991	2720
TH92	MCS	7.37 L GI gun array	12/ 24	Demultiplex, processing sample interval, time zero adjustment, band pass filter, noise trace edit, CDP sort, spherical divergence compensation, AGC, deconvolution, velocity analysis, normal moveout, CDP stack, post stack deconvolution, time variant band pass filter, datum correction, trace balance, two trace mixing, trace scaling	8	1992	2143
TH95	MCS	9.83 — 13.76 L GI gun array	48	Demultiplex, two traces summation, band pass filter, noise trace edit, CDP sort, spherical divergence compensation, AGC, deconvolution, velocity analysis, normal moveout, CDP stack, post stack deconvolution, time variant band pass filter, datum correction, trace balance, two trace vertical stack, trace scaling	8	1995	1206
NBP9307	SCS (Paper only)					1993	4713

NBP9401	SCS (Paper only)	50 in^3 GI air gun				1994	4100
NBP9501	SCS (Paper only)	50 in^3 GI air gun				1995	3041
NBP9902	SCS (Paper only)					1999	935

Supplemental Table 2: Seismic refraction solutions for sonobuoy measurements. Modified from Cochrane et al., 1992

Sonobuoy No	Expedition	Latitude	Longitude	Water Depth (m)	Layer 1 Thickness (m)	Layer 1 Velocity (m/s)
2	S.P. Lee 1984	-77.19	163.93	271	500	2090
6	S.P. Lee 1984	-77.03	165.85	860	180	1860
7	S.P. Lee 1984	-77.27	163.89	945	650	1920
9	S.P. Lee 1984	-76.65	167.72	827	30	1920
10	S.P. Lee 1984	-76.31	164.93	850	810	1900
11	S.P. Lee 1984	-75.95	163.17	728	120	2970
12	S.P. Lee 1984	-75.96	164.82	898	900	1930
13	S.P. Lee 1984	-76.01	166.77	690	190	1920
14	S.P. Lee 1984	-76.02	169.24	569	120	1930
15	S.P. Lee 1984	-75.77	169.03	486	90	1910
17	S.P. Lee 1984	-75.16	165.91	856	150	1950
18	S.P. Lee 1984	-75.00	167.51	525	160	1900
19	S.P. Lee 1984	-75.02	170.94	541	20	1930
20	S.P. Lee 1984	-74.83	172.34	592	30	2190
21	S.P. Lee 1984	-74.49	170.15	465	320	1940
22	S.P. Lee 1984	-74.13	168.75	629	200	2280

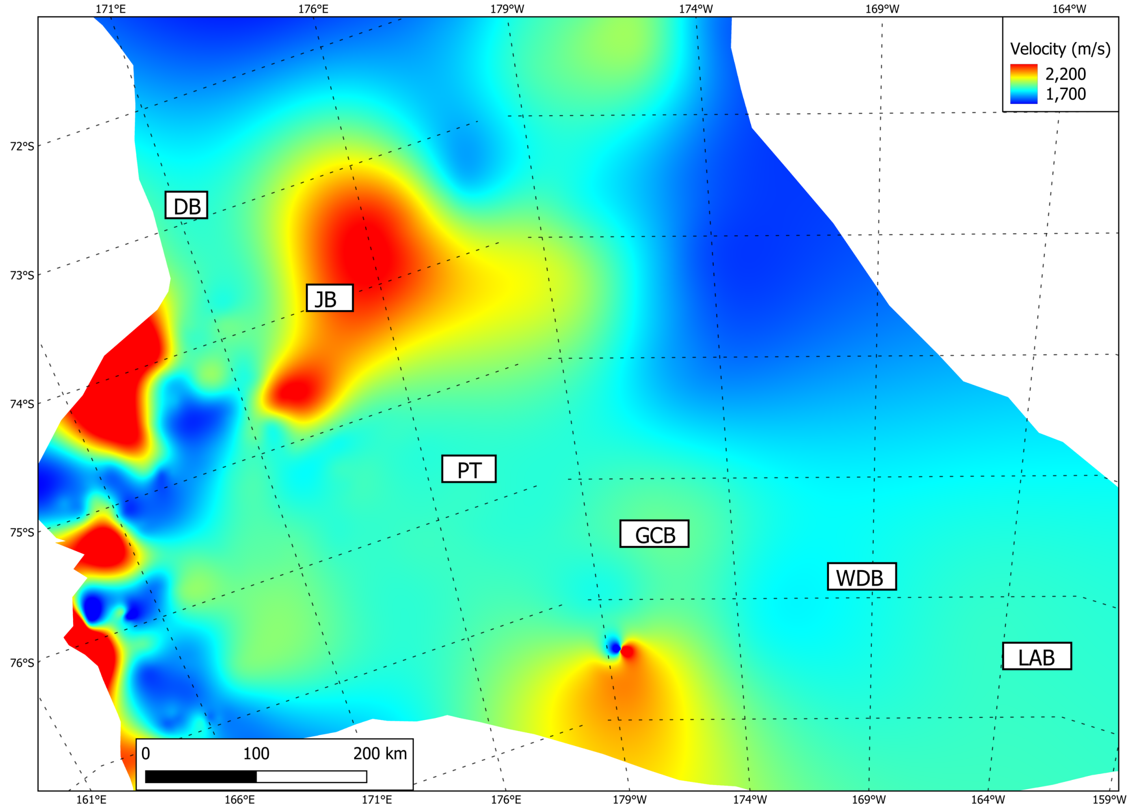
23	S.P. Lee 1984	-74.05	171.25	569	340	1930
24	S.P. Lee 1984	-74.02	170.20	557	290	1920
26	S.P. Lee 1984	-74.31	169.09	695	190	1930
27	S.P. Lee 1984	-74.69	167.45	825	420	2210
28	S.P. Lee 1984	-75.20	166.20	873	110	1790
29	S.P. Lee 1984	-75.99	164.93	918	460	1720
30	S.P. Lee 1984	-76.43	164.92	808	150	1790
31	S.P. Lee 1984	-76.93	165.00	565	140	1780
32	S.P. Lee 1984	-72.55	-178.31	554	160	1920
33	S.P. Lee 1984	-72.53	-175.95	818	270	1970
34	S.P. Lee 1984	-72.52	-173.60	3344	490	1790
35	S.P. Lee 1984	-72.13	-177.29	700	180	1920
37	S.P. Lee 1984	-72.10	179.30	2218	690	1800
38	S.P. Lee 1984	-71.38	174.90	2330	550	1700
39	S.P. Lee 1984	-70.72	175.28	2416	310	1700
44	Polar Queen 1988	-76.00	177.22	466	90	1900
45	Polar Queen 1988	-76.00	175.48	569	420	1900
46	Polar Queen 1988	-76.00	173.90	533	360	1900
47	Polar Queen 1988	-76.00	172.25	600	320	1900
48	Polar Queen 1988	-76.00	170.59	690	140	1930

50	Polar Queen 1988	-75.60	173.34	503	290	1900
51	Polar Queen 1988	-76.12	173.33	630	290	1900
52	Polar Queen 1988	-76.42	173.34	578	430	1900
53	Polar Queen 1988	-75.41	165.20	451	780	2360
54	Polar Queen 1988	-75.01	165.50	1103	210	1900
55	Polar Queen 1988	-75.39	176.51	361	590	1900
56	Polar Queen 1988	-75.29	174.92	293	400	1900
57	Polar Queen 1988	-75.22	173.43	480	350	1900
59	Polar Queen 1988	-75.01	171.40	577	80	1900
60	Polar Queen 1988	-75.18	-175.25	317	820	1800
61	Polar Queen 1988	-74.76	-175.26	279	920	1800
62	Polar Queen 1988	-74.31	-175.24	433	640	1800
63	Polar Queen 1988	-73.75	-175.24	395	660	1800
61	Polar Queen 1988	-74.63	168.24	580	440	1930
62	Polar Queen 1988	-73.97	171.51	493	350	1900

63	Polar Queen 1988	-74.52	171.50	428	210	1900
64	OGS Explora 1989	-75.47	174.00	297	410	1900
65	OGS Explora 1989	-75.28	172.21	522	120	1900
66	OGS Explora 1989	-75.29	170.01	370	260	1900
67	OGS Explora 1989	-75.47	173.33	442	420	1900
68	OGS Explora 1989	-75.38	175.25	319	470	1900
69	OGS Explora 1989	-73.53	178.60	334	200	1900
70	OGS Explora 1989	-73.58	-177.39	1014	620	1870
71	OGS Explora 1989	-74.38	-178.97	303	800	2010
72	OGS Explora 1989	-76.37	-176.09	580	340	1930
74	OGS Explora 1989	-77.45	-174.00	544	240	1900
75	OGS Explora 1989	-77.45	-178.50	525	60	2220
76	OGS Explora 1989	-77.45	-178.51	660	290	1830
77	OGS Explora 1989	-77.12	-178.69	638	210	1900
78	OGS Explora 1989	-76.33	-179.76	371	130	1900

79	OGS Explora 1989	-76.29	177.00	443	470	1900
80	OGS Explora 1989	-75.44	177.00	404	450	1900
81	OGS Explora 1989	-73.72	176.98	372	10	2150
87	OGS Explora 1990	-74.88	165.48	782	470	1800
88	OGS Explora 1990	-74.97	164.71	920	270	1800
89	OGS Explora 1990	-75.07	168.11	316	410	1800
90	OGS Explora 1990	-75.04	164.92	929	280	1800
91	OGS Explora 1990	-75.37	166.65	476	410	1800
92	OGS Explora 1990	-75.91	166.35	507	410	1800
93	OGS Explora 1990	-76.05	164.92	883	980	1800
94	OGS Explora 1990	-75.93	163.79	730	390	1800
95	OGS Explora 1990	-75.84	164.67	773	880	1800
96	OGS Explora 1990	-75.92	163.72	697	410	1800
97	OGS Explora 1990	-75.94	163.96	714	340	1800
98	OGS Explora 1990	-75.92	164.21	681	430	1800

99	OGS Explora 1990	-76.99	164.78	440	740	1800
100	OGS Explora 1990	-77.02	166.01	833	950	1800
101	OGS Explora 1990	-77.14	166.30	936	360	1800
102	OGS Explora 1990	-77.59	164.56	263	290	1800
103	OGS Explora 1990	-76.95	164.41	387	310	1800
104	OGS Explora 1990	-77.08	166.34	933	630	1800
105	OGS Explora 1990	-76.88	164.96	574	560	1800
106	OGS Explora 1990	-76.53	166.26	630	410	1800
107	OGS Explora 1990	-70.29	166.28	604	360	1800
108	OGS Explora 1990	-75.03	167.75	419	370	1800
109	OGS Explora 1990	-74.85	166.19	1080	440	1800
110	OGS Explora 1990	-75.06	169.24	370	340	1800
111	OGS Explora 1990	-74.80	170.42	300	490	1800
112	OGS Explora 1990	-74.56	169.15	537	290	1800
113	OGS Explora 1990	-63.01	166.85	2357	610	1800



Supplemental Figure 1. Interval velocity map of the Ross Sea created from interpolation of the refraction sonobuoy data reported in Cochrane et al., (1992). Interval velocities varied laterally from 1700 m/s to 2200 m/s within this layer of sediment. This interval velocity map was used as the input to a velocity model constructed in Petrel that was subsequently used for depth conversion of time-thickness maps.

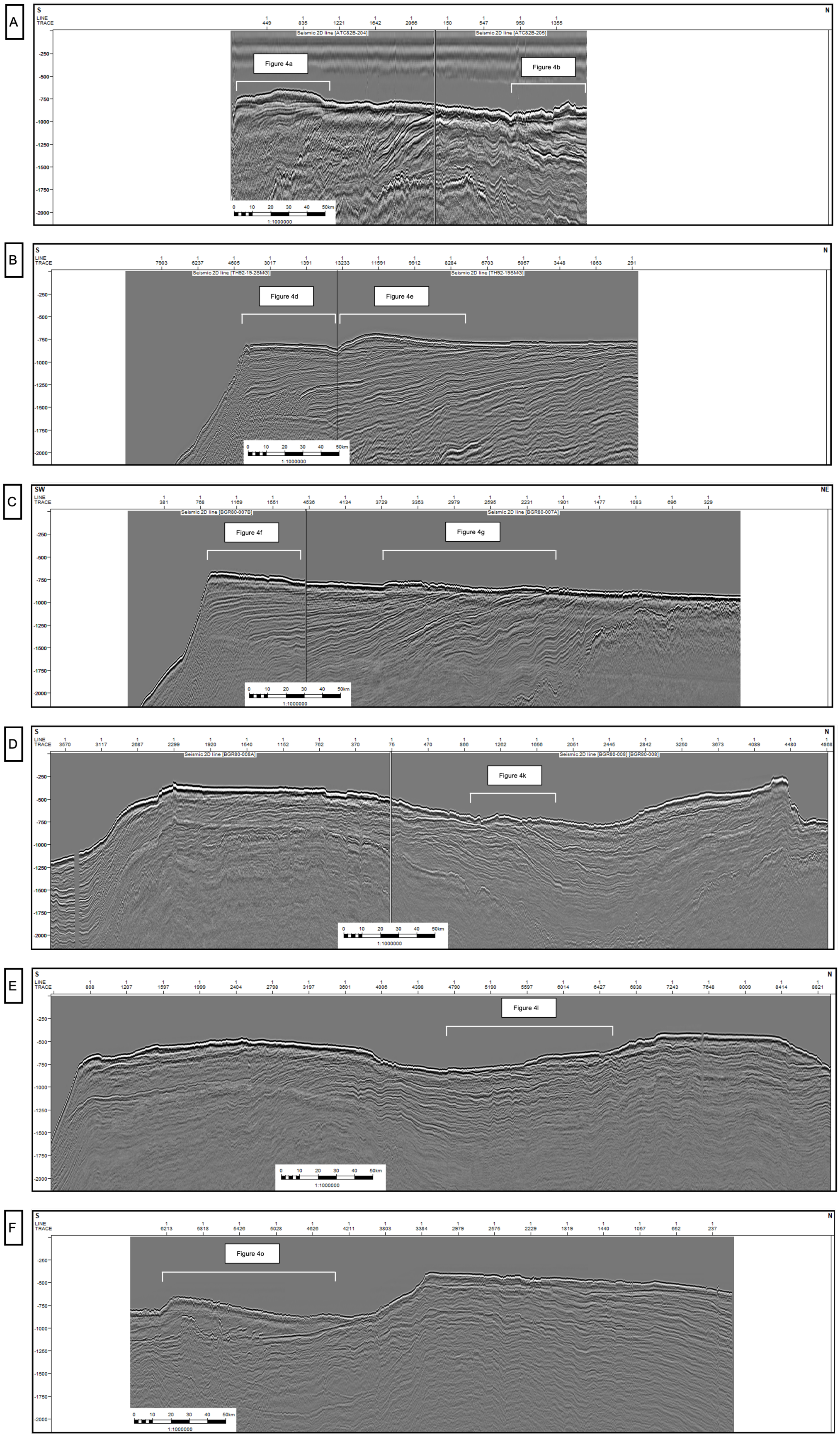
Appendix 1: Catalogue of Ross Sea GZWs

The GZWs mapped in this study match those identified in other regional studies using seismic data and multibeam bathymetry (Supplemental Table 3). In LAB all three of the mapped GZWs (Table 1 and Figure 4: a, b and c) have been previously identified from NBP9902 seismic lines (Mosola and Anderson, 2006). In WDB, the outer shelf and middle shelf GZWs (Table 1 and Figure 4: d and e) have been mapped using surveys such as PD90, NBP9307, NBP9501, NBP9902, NBP0802 and NBP1502 (Mosola and Anderson, 2006; Bart et al., 2017; Danielson and Bart, 2019). The outer shelf and middle shelf GZWs in GCB (Table 1 and Figure 4: f and g) were identified using the surveys PD90, NBP9401, NBP9501, NBP0301A, NBP0802 (Bart and Owolana, 2012). The GCB Inner Reaches East GZW (Table 1 and Figure 4: h) was previously mapped from a regional multibeam bathymetry study (Halberstadt et al., 2016). The two IR of the MCS GZWs in western GCB (Table 1 and Figure 4: i and j) have been identified and mapped for this study. The outer shelf GZW in PT was first identified using the seismic survey of NBP9401 (Table 1 and Figure 4: k). The middle shelf GZWs in JB and DT (Table 1 and Figure 4: l and o) were first identified using the seismic surveys of NBP9401 and NBP9501 (Shipp et al., 1999). The IR JOIDES GZW near Franklin Island (Table 1 and Figure 4: m) has been identified from multibeam bathymetry and has been cored (Halberstadt et al., 2016; Prothro et al., 2020). The remaining GZWs in the IR of the MCS of JB and DB (Table 1 and Figure 4: n, p, q) have been identified and mapped for this study.

Supplemental Table 3: Catalogue of Ross Sea Grounding zone wedges

GZW Wedge Location	References
a. LAB Outer Shelf	Mosola and Anderson, 2006
b. LAB Middle Shelf	Mosola and Anderson, 2006
c. LAB Middle Shelf Inner Reaches	Mosola and Anderson, 2006
d. WDB Outer Shelf	Bart et al., 2017; Mosola and Anderson, 2006
e. WDB Middle Shelf	Bart et al., 2017; Mosola and Anderson, 2006
f. GCB Outer Shelf	Bart and Owolana, 2012
g. GCB Middle Shelf West	Bart and Owolana, 2012
h. GCB Inner Reaches East	Halberstadt et al., 2016
i. GCB Inner Reaches West	This study
j. GCB Inner Reaches Ross Bank	This study
k. PT Middle Shelf	Shipp et al., 1999

l. JOIDES Middle Shelf	Shipp et al., 1999
m. JOIDES Inner Reaches 1	Halberstadt et al., 2016; Prothro et al., 2020
n. JOIDES Inner Reaches 2	This study
o. DT Outer Shelf	Shipp et al., 1999
p. DT Inner Reaches 1	Baroni et al., 2022
q. DT Inner Reaches 2	Baroni et al., 2022


A
Figure 4a
Figure 4b
B
Figure 4d
Figure 4e
C
Figure 4f
Figure 4g
D
Figure 4k
E
Figure 4l
F
Figure 4o
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Supplemental Figure 2. Collection of composite seismic lines in major troughs of Ross Sea that show the major trough GZWs in Ross Sea. Positions indicated in Figure 1 with A corresponding with LAB, B with WDB, C with GCB, D with PT, E with JB and F with DT. GZWs from Figure 4 are labeled where present along the cross sections.