Supplementary Materials

Identifier	Shelf	Lat (°)	Lon (°)	Brine	Reference
J-9	Ross	-82.375	-168.626	N	(Zotikov et al., 1980)
J9	Ross	-78.367	179.85	N	(Herron and Langway, 1979)
T340	Ronne	-79.4	-64.5	N	(Graf et al., 1988)
B04	Ekströmisen	-70.62	-8.367	N	(Schlosser and Oerter, 2002)
B03	Ekströmisen	-70.62	-8.367	N	(Schlosser et al., 1999)
FB0198	Ekströmisen	-70.73	-8.19	N	(Schlosser and Oerter, 2002)
B15	Filchner-Ronne	-77.935	-55.9361	N	(Graf et al., 1994)
B13	Filchner-Ronne	-76.9811	-52.2678	N	(Graf et al., 1994)
Little America V	Ross	-78.167	-162.22	N	(Gow, 1968)
Lazarev	Lazarev	-69.967	12.92	Y	(Dubrovin, 1960)
Base Roi Baudouin	Roi-Baudouin	-70.4314	24.3106	N	(Tongiorgi et al., 1962)
G1	Amery	-69.451	71.497	N	(Budd et al., 1982)
C-16	Ross	-81.1935	170.4978	N	(Chiang and Langway, 1978)
Q-13	Ross	-78.9568	179.9229	N	(Chiang and Langway, 1978)
R7	Brunt	-75.4	-25.5	Y	(Thomas, 1975)

Table S1: Sources for firn core data mapped in Figure 2.

Shelf	Lat	Lon	Location notes	Reference
Ross	-82.43	169.7		(Neal, 1979)
Ross	-	-	"Transition from valley glacier to ice shelf"	(Robin et al., 1970)
Larsen C	-68	-60	Near rifts in ice shelf	(Smith, 1972; Smith and Evans, 1972)
Wordie	-	-	Towards edges of shelf	(Swithinbank, 1968)
Wilkins	-	-	Map in Figure 4	(Vaughan et al., 1993)
McMurdo	-	-	Map in Figure 5	(Grima et al., 2016)
Brunt	-75.31	-26.7	Attributed to basal marine ice by Walford (1964) but to brine infiltration by Swithinbank (1968)	(Swithinbank, 1968; Walford, 1964)

Table S2: Sources for radar observation of brine on Antarctic ice shelves, mapped in Figure 2.
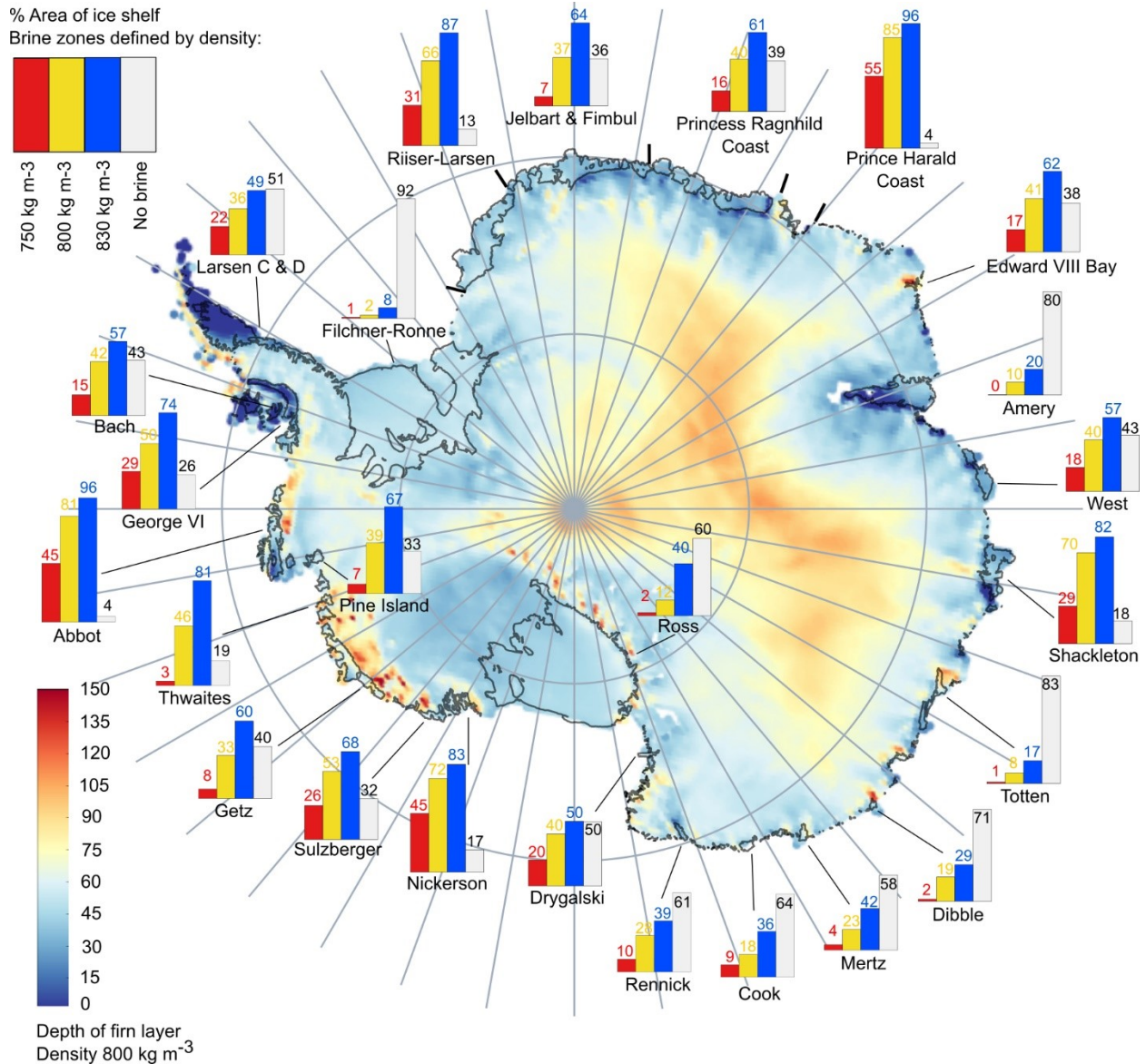
Figure S1: Depth of 800 kg m⁻³ firn layer. Data taken from firn densification model IMAU-FDM (Ligtenberg et al., 2011). Bar charts show the percentage area of selected ice shelves covered by the brine zone, defined with a threshold for firn permeability of 750 kg m⁻³ (red), 800 kg m⁻³ (yellow) and 830 kg m⁻³ (blue). Regions with particularly thick firn layers include Edward VIII Bay and Totten IS.
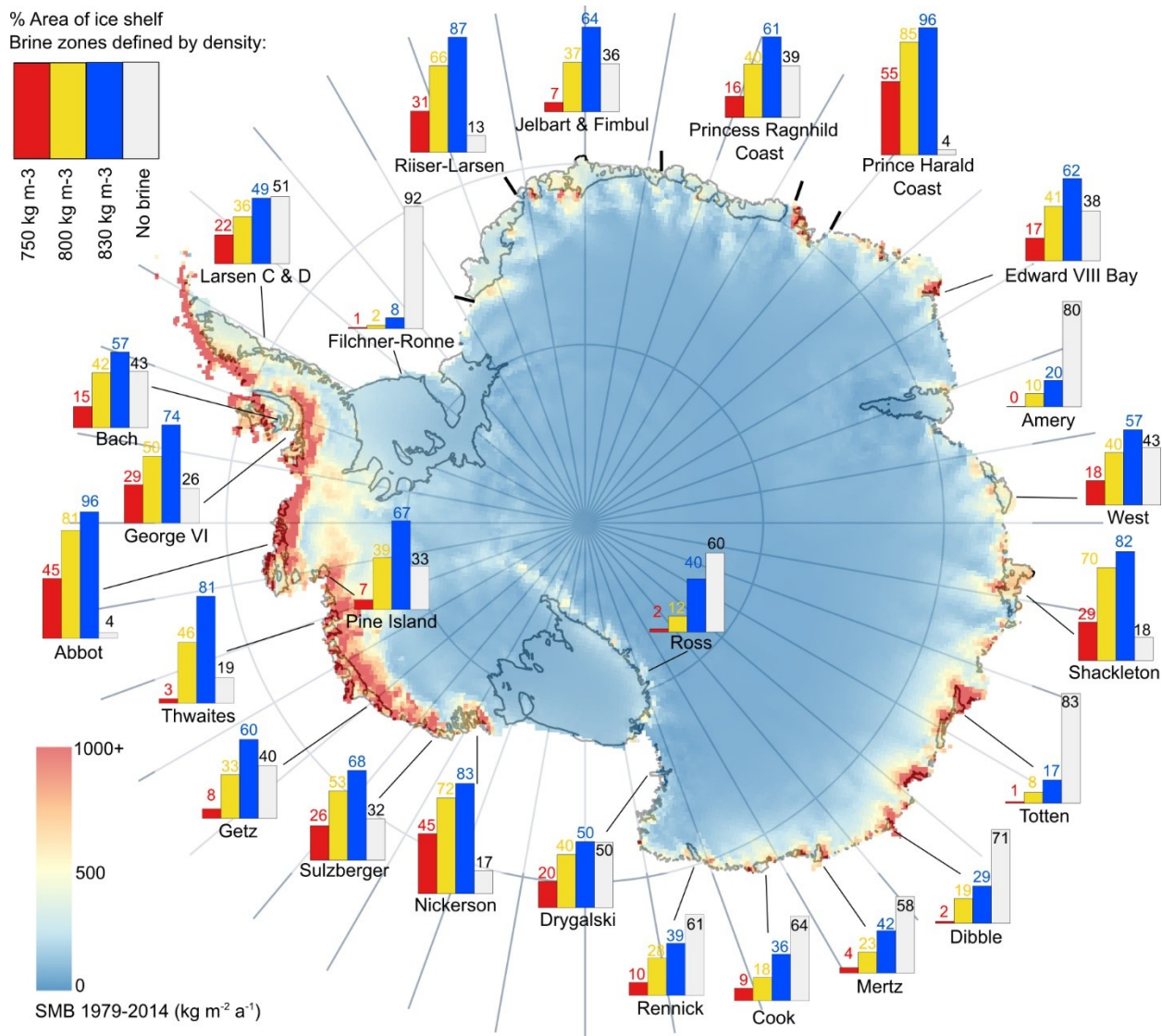
Figure S2: Surface mass balance in kg per square metre per annum (Van Wessem et al., 2014). Bar charts show the percentage area of selected ice shelves covered by the brine zone, defined with a threshold for firn permeability of 750 kg m^{-3} (red), 800 kg m^{-3} (yellow) and 830 kg m^{-3} (blue). High accumulation rates coincide with shelves with large brine zones in the West Antarctic e.g. Abbot, Bach, Sulzberger & Nickerson Ice Shelves as well as in other areas e.g. Edward VIII Bay.
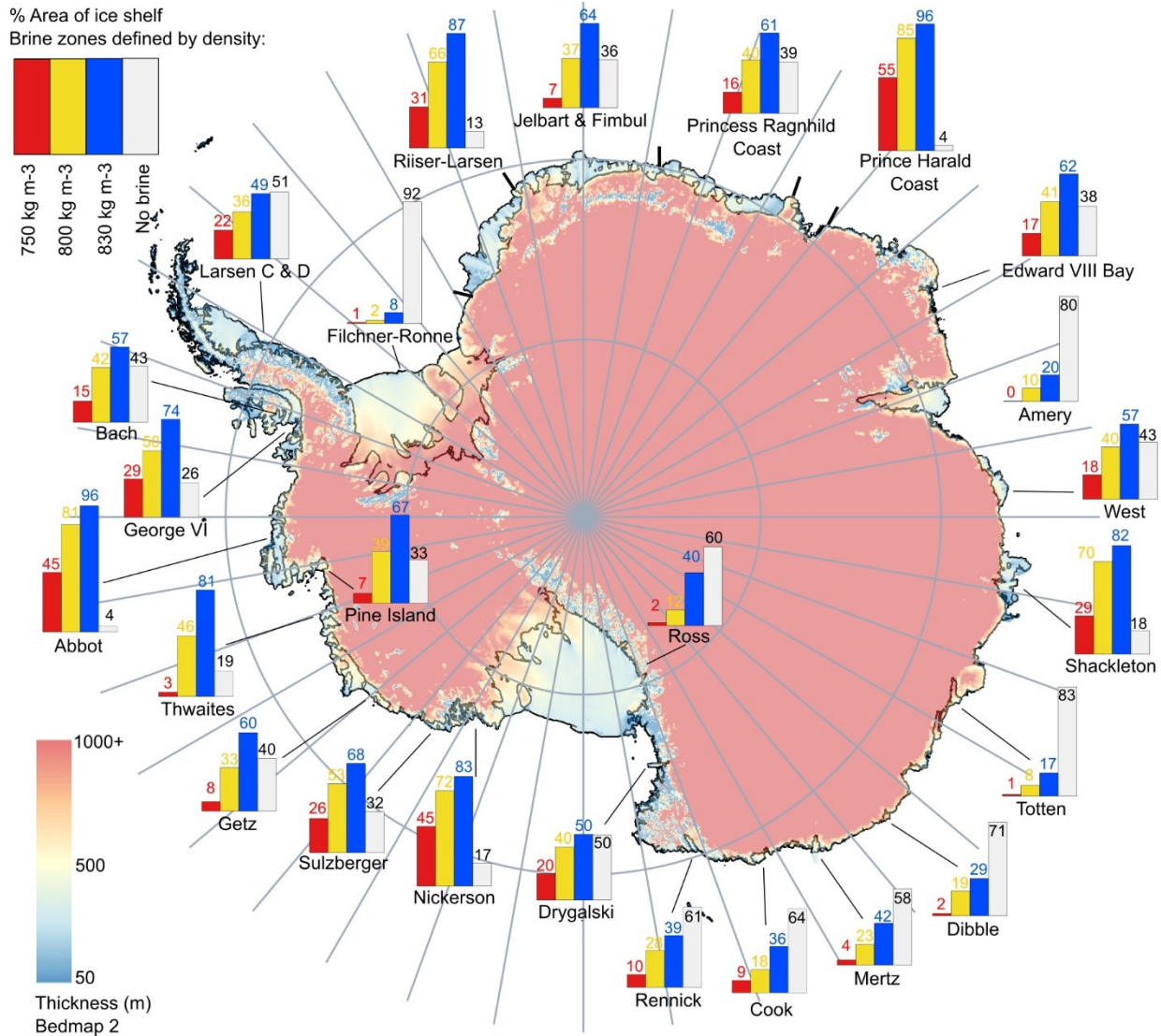
Figure S3: Ice thickness from Bedmap2 (Fretwell et al., 2013). Bar charts show the percentage area of selected ice shelves covered by the brine zone, defined with a threshold for firn permeability of 750 kg m^{-3} (red), 800 kg m^{-3} (yellow) and 830 kg m^{-3} (blue). Some ice shelves with a large brine zone coincide with areas of low ice thickness e.g. Riiser-Larsen and Princess Ragnhild regions and the Shackleton Ice Shelf.
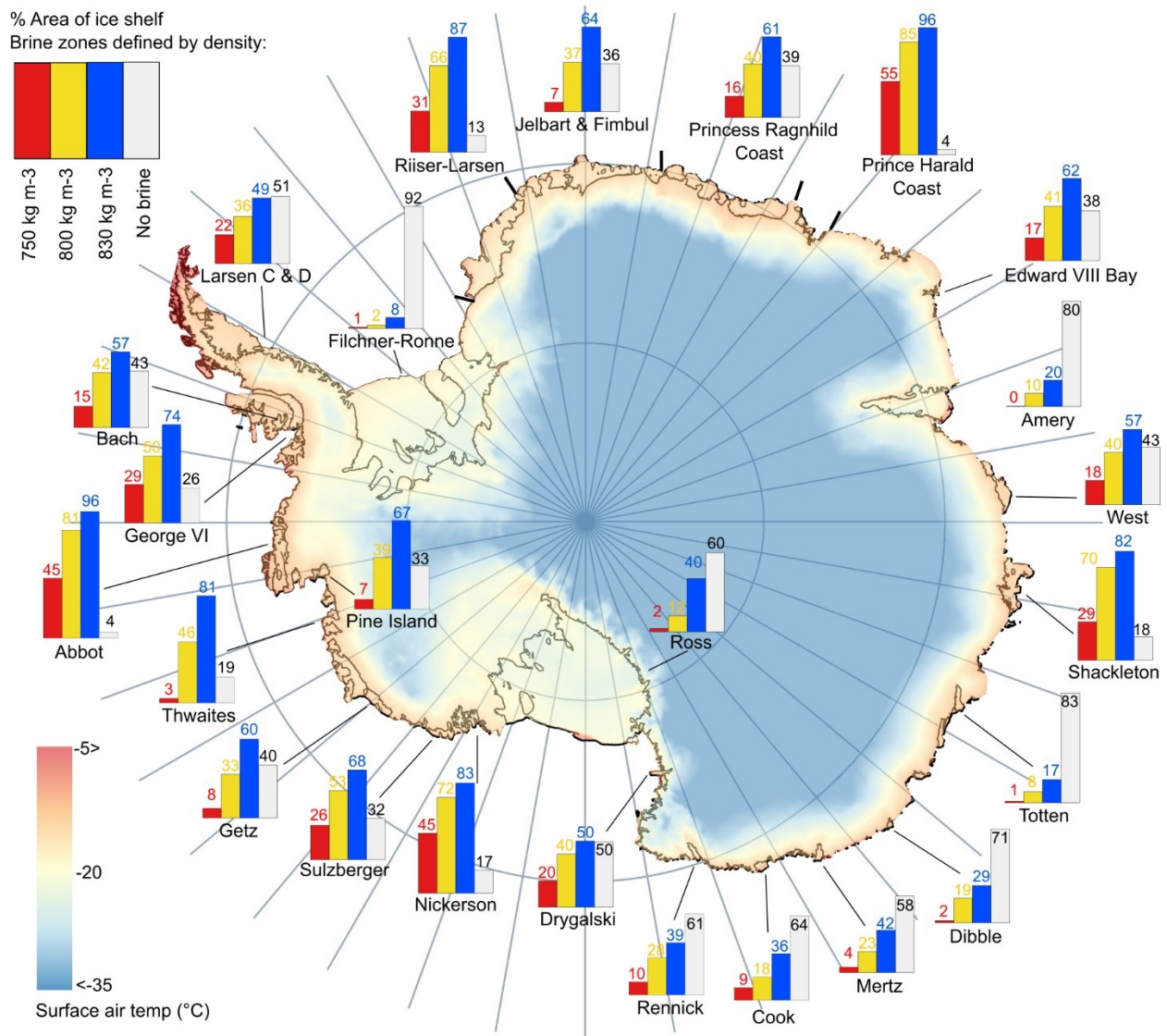
Figure S4: Surface air temperature from ALBMAPv1 Antarctic dataset (Le Brocq et al., 2010; Comiso, 2000). Annual mean temperatures averaged from 1982–2004. Bar charts show the percentage area of selected ice shelves covered by the brine zone, defined with a threshold for firn permeability of 750 kg m^{-3} (red), 800 kg m^{-3} (yellow) and 830 kg m^{-3} (blue). Very low annual mean temperatures will be reflected in the firn layer, and may cause freezing of seawater which will prevent its further infiltration.
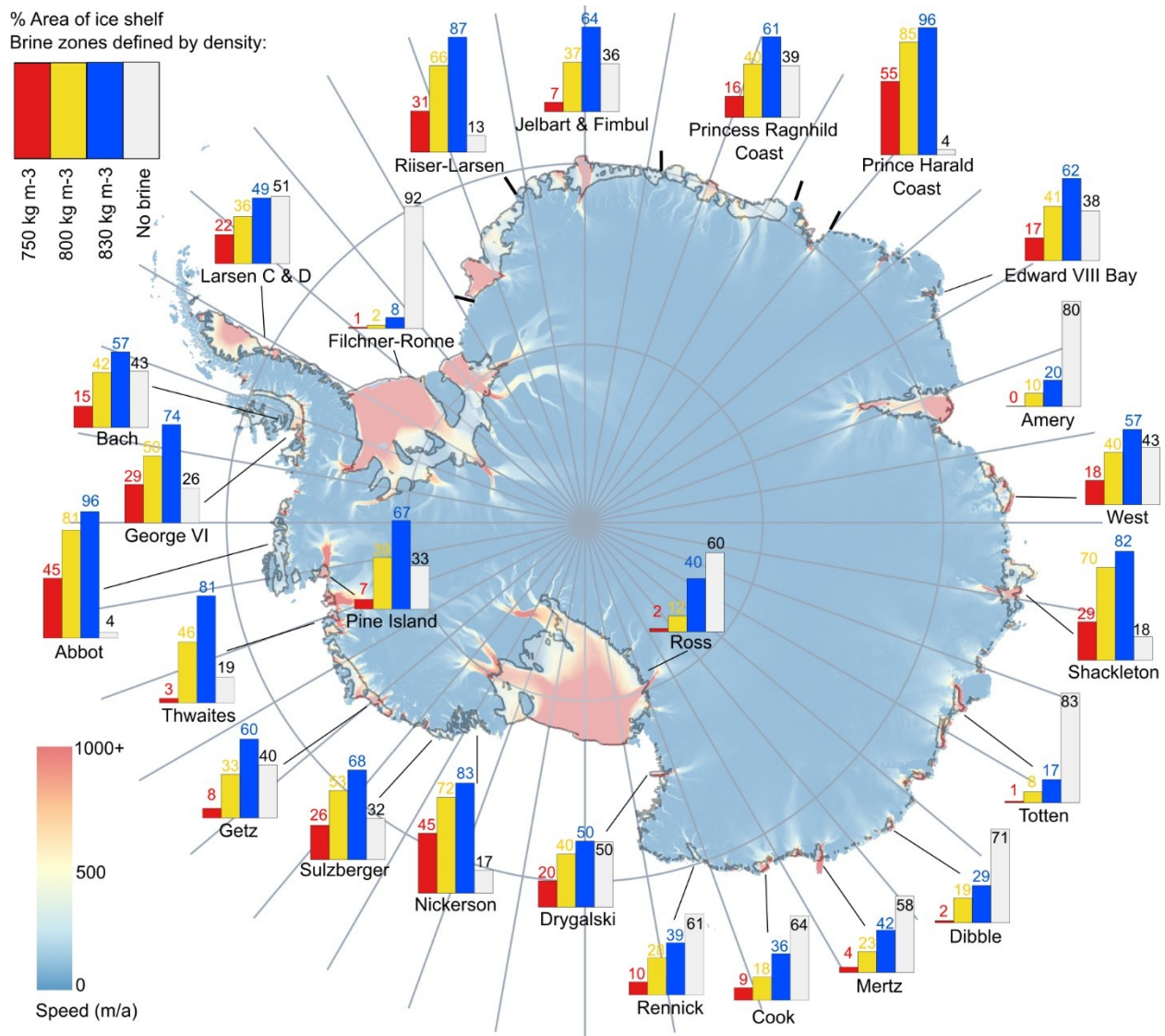
Figure S5: Ice speed from MEaSUREs InSAR-based Antarctica ice velocity map (Mouginot et al., 2017). Bar charts show the percentage area of selected ice shelves covered by the brine zone, defined with a threshold for firn permeability of 750 kg m^{-3} (red), 800 kg m^{-3} (yellow) and 830 kg m^{-3} (blue). Ice shelves with high flow speeds are less likely to be able to maintain a steady state area of liquid brine, if infiltration occurs from the calving front.
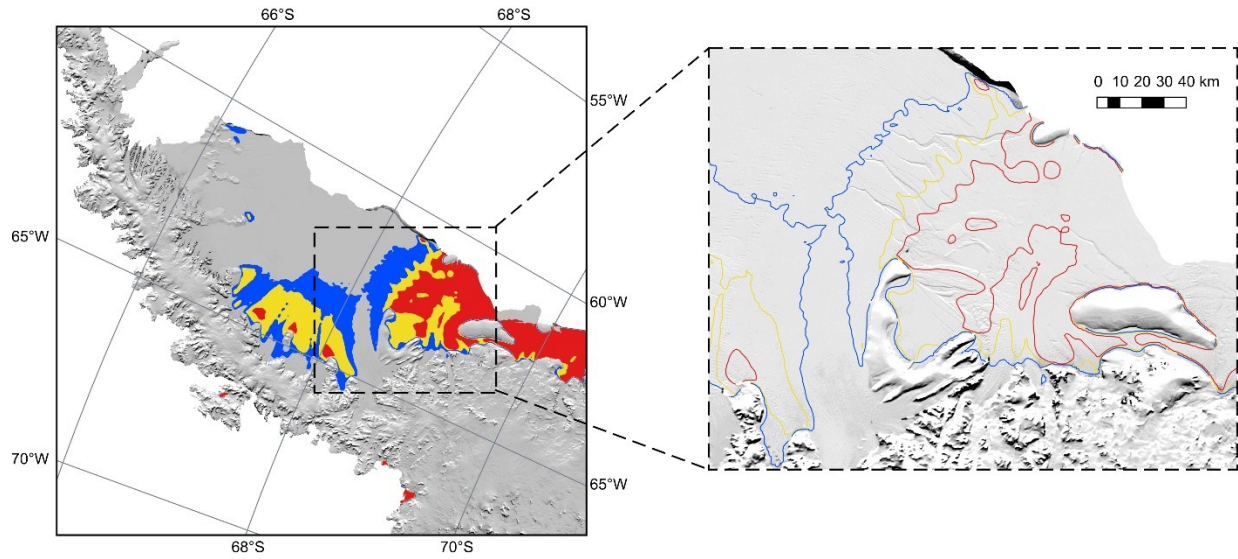
Figure S6: Brine zones on Larsen C ice shelf align with the source of rifts. Coloured areas show potential brine zones as described in Fig. 1. Background imagery is from MODIS Mosaic of Antarctica. The potential brine zone coincides with a region of rifting on the south side of the ice shelf.

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