Supplementary material for:
Frequent resuspension of glaciomarine coastal sediments as an important source of reactive iron to the West Antarctic Peninsula

Authors: Rhiannon L. Jones[1,2]*, Maeve C. Lohan[2], Tobias Ehmen[3], Lisa Friberg[4], Ben Lincoln[5], Katy Sheen[6], Siobhan Foden[1], Katrien Van Landeghem[5], Kate Retallick[5], George Dadd[7], James Scourse[6], Amber L. Annett[2]

*Corresponding author: rhines@bas.ac.uk

1. British Antarctic Survey, Cambridge, UK
2. School of Ocean and Earth Science, University of Southampton, Southampton, UK
3. Bjerknes Centre for Climate Research, University of Bergen, Norway
4. School of Earth Sciences, University of Bristol, UK
5. School of Ocean Sciences, Bangor University, UK
6. Earth and Environmental Science, University of Exeter
7. Kiote Ltd, UK

Supplementary Text:

Ultrafiltration for soluble Fe

Briefly, in a laminar flow hood, a peristaltic pump was fitted with Teflon tubing and PVC pump tubing (grey-grey, Elkay) and run at 7 rpm to filter at a rate of approximately 1 mL min-1. Six 0.02 µm Anatop 25 mm disc filters (Whatman©) were fitted to Teflon tubing and placed in a stand with six 60 mL LDPE Nalgene bottles fitted underneath to catch the filtrate. Pump lines were initially cleaned prior to sample filtration using 10% HCl (ROMIL SpA™) for > 1 hour. Subsequently between each filtration, lines were cleaned with 20 mL of 0.1 % ultrapure HCl (ROMIL-UpA™) followed by > 60 mL UHP (Milli-Q). Between filtration periods, subsample lines were left filled with UHP water to avoid drying. The dFe sample was pumped through the lines, and the first 10 – 20 mL of filtrate was used to rinse the subsample bottle and discarded. Bottles were then filled with ultrafiltered water for the sFe subsample. A summary of the experimental set-up is provided in Figure 2.

FI-CL for Fe species

Using FI-CL to measure Fe is based on the catalytic effect of Fe(III) ions on the oxidation of luminol to generate blue luminescence, the intensity of which is detected using a photomultiplier tube. Each sample was spiked 1 h prior to analysis with 0.013 M H_2O_2 to ensure oxidation of all Fe(II) to Fe(III) (Lohan et al., 2006). Samples were buffered in-line with ammonium acetate (ROMIL-SpA™) to a pH of 3.5 – 4.0 and then preconcentrated onto Toyopearl-AF-Chelate 650 M resin for > 15 s at a flow rate of 1.5 ml min^{-1}. This was followed by rinsing with weak 0.013 M HCl (Romil, SpA), before using 0.24 M HCl (ROMIL-SpA™) to liberate the Fe from the resin. To start the luminescent reaction, Fe was then mixed with a 0.015 mM luminol solution, spiked with 70 µl L^{-1} triethylenetetramine (Sigma-Aldrich). The luminol was buffered to pH ~9.5 using a 1 M ammonia solution (ROMIL-SpA™). The final reagent, 0.4 M H_2O_2, was added to produce chemiluminescence, which was measured using a photomultiplier tube (Hamamatsu, H82259) to detect the light signal (425 nm).

Figure S1: Solid sediment analysis of the Fe and Al wt% and the Fe/Al ratios plotted for each site. The bulk upper crust (Bulk UC) and bulk WAP sediment (Bulk WAP) wt% and ratios are also plotted, from Taylor and McLennan (1985) and Angino (1966).

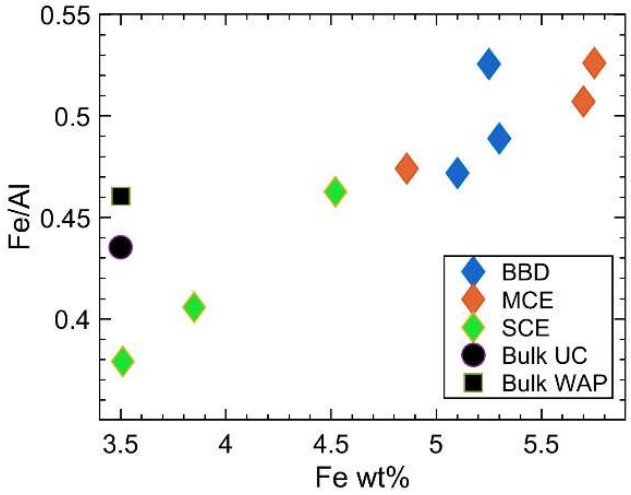


Figure S2: Maps showing EK80 transects (shown in Figure S3, Figure 7 of the main text, and Figure S4), at each bay: Marian Cove, King George Island; Borgen Bay, Anvers Island, and Sheldon Cove, Adelaide Island.

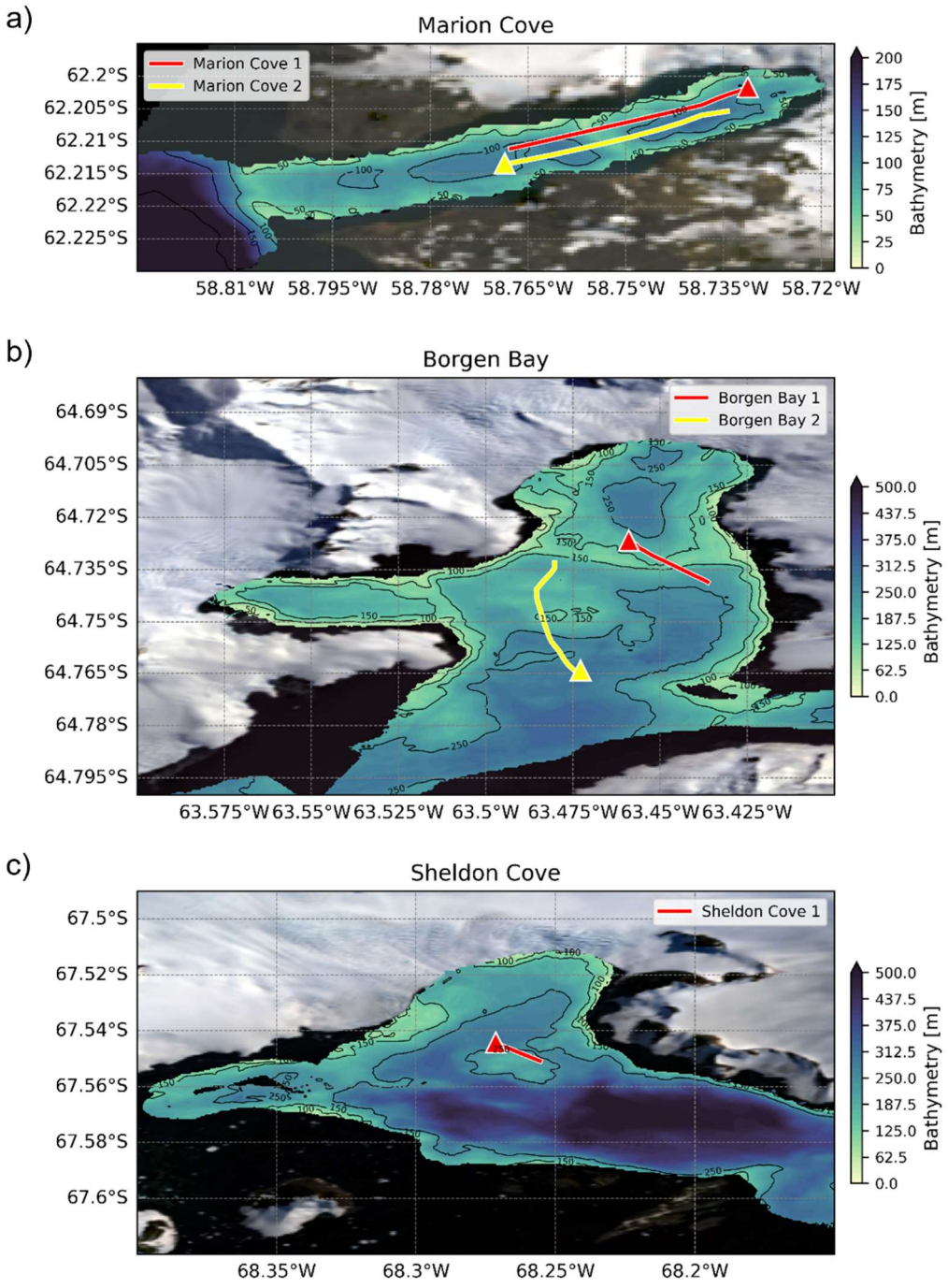


Figure S3: EK80 backscatter within the water column collecting in January 2020 from Marian Cove, showing a) the transect moving northeast into the bay; b) the transect moving southwest out of the bay. Lower panel shows current velocity averaged over depth. Backscatter from the seafloor is shown by backscatter values >-80 dB at the bottom of the images. High backscatter at shallower depths likely represents krill swarms or other large biomass. See map Figure S2a for track location.

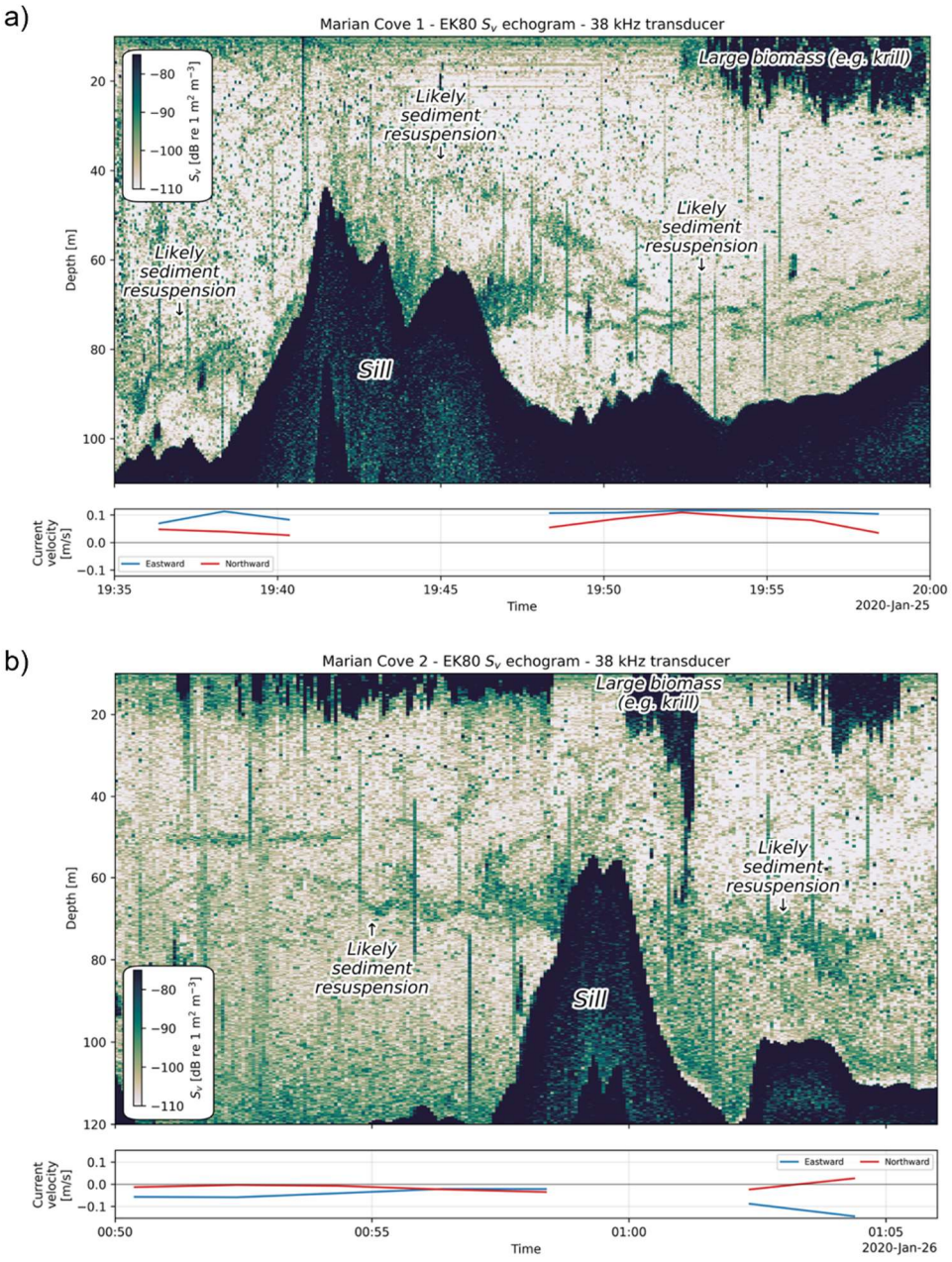


Figure S4: EK80 backscatter within the water column collected in December 2018 from Sheldon Cove moving over the inner sill. Lower panel shows current velocity averaged over depth. High backscatter at shallower depths likely represents krill swarms or other large biomass. See map Figure S2c for track location.

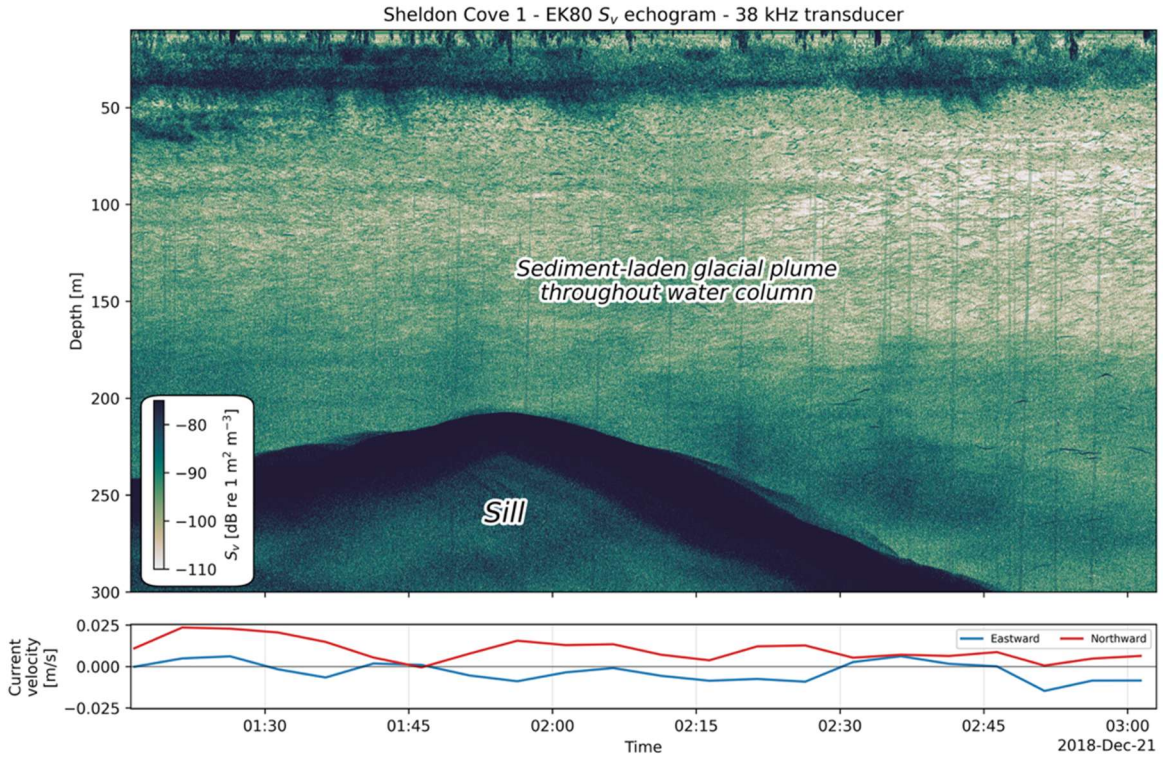
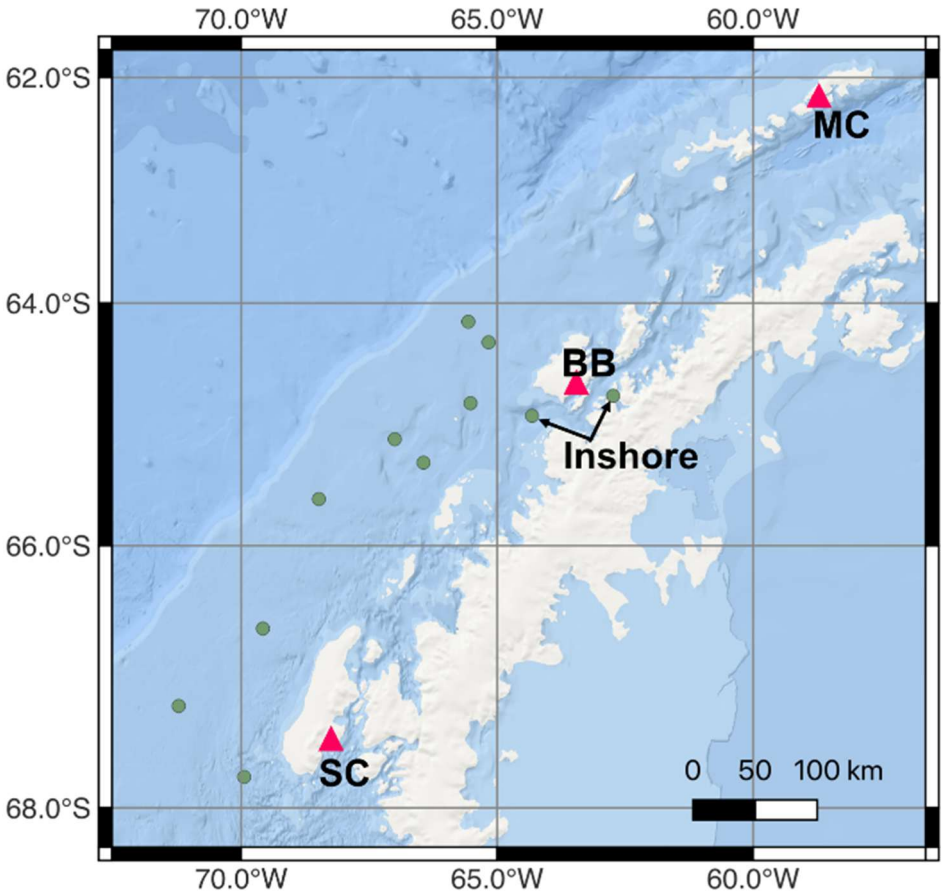


Figure S5: Location of coring sites across the WAP shelf from this study (pink dots) and Burdige and Christensen (2022) (green dots), with the inshore sites annotated. All other stations are defined as offshore. Bathymetry is from the Antarctica and the Southern Ocean basemap (data.bas.ac.uk) using IBSCO v2 (Dorschel et al., 2022).



References

Dorschel, B., Hehemann, L., Viquerat, S., Warnke, F., Dreutter, S., Tenberge, Y. S., Accettella, D., An, L., Barrios, F., & Bazhenova, E. (2022). The international bathymetric chart of the southern ocean version 2. *Scientific Data*, *9*(1), 275.

Lohan, M. C., Aguilar-Islas, A. M., & Bruland, K. W. (2006). Direct determination of iron in acidified (pH 1.7) seawater samples by flow injection analysis with catalytic spectrophotometric detection: Application and intercomparison. *Limnology and Oceanography: Methods*, *4*(6), 164-171.