HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES

ALFRED-WEGENER-INSTITUT
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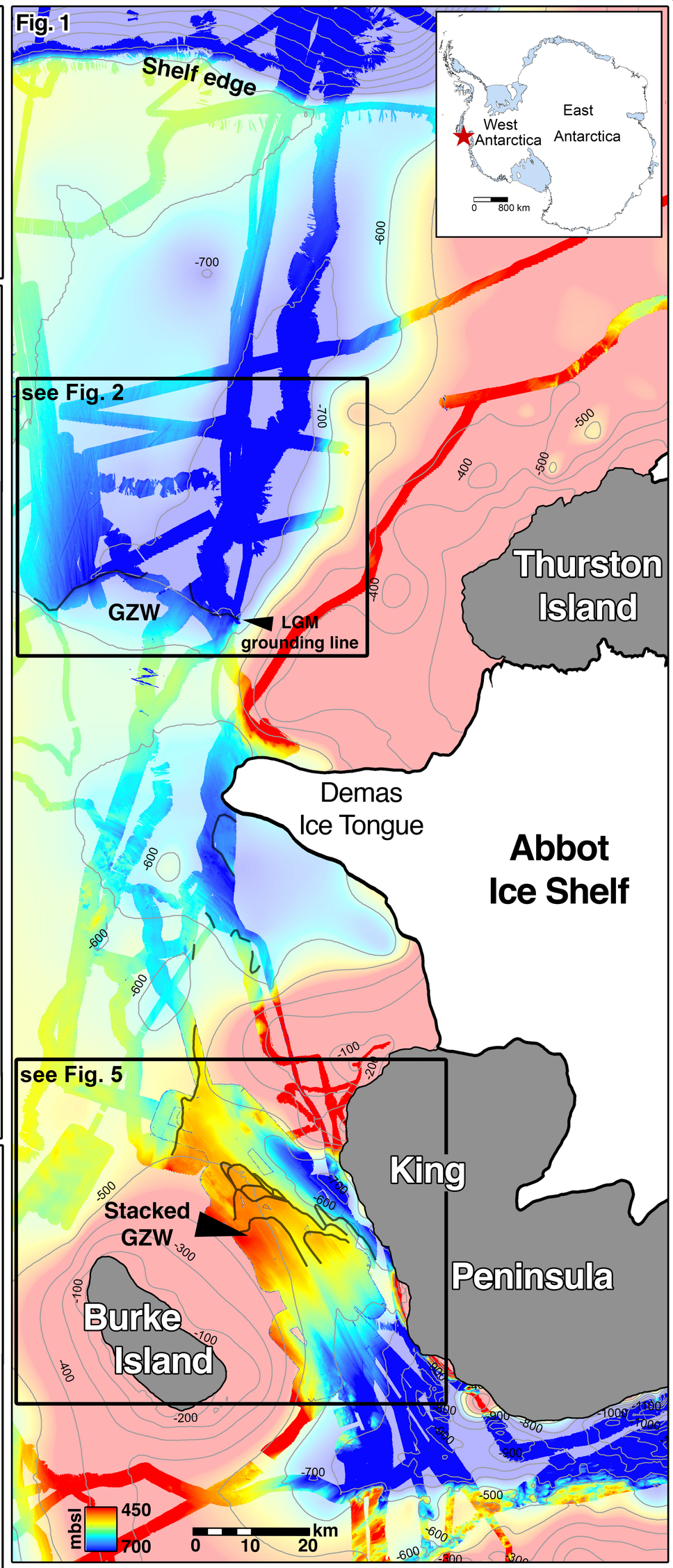
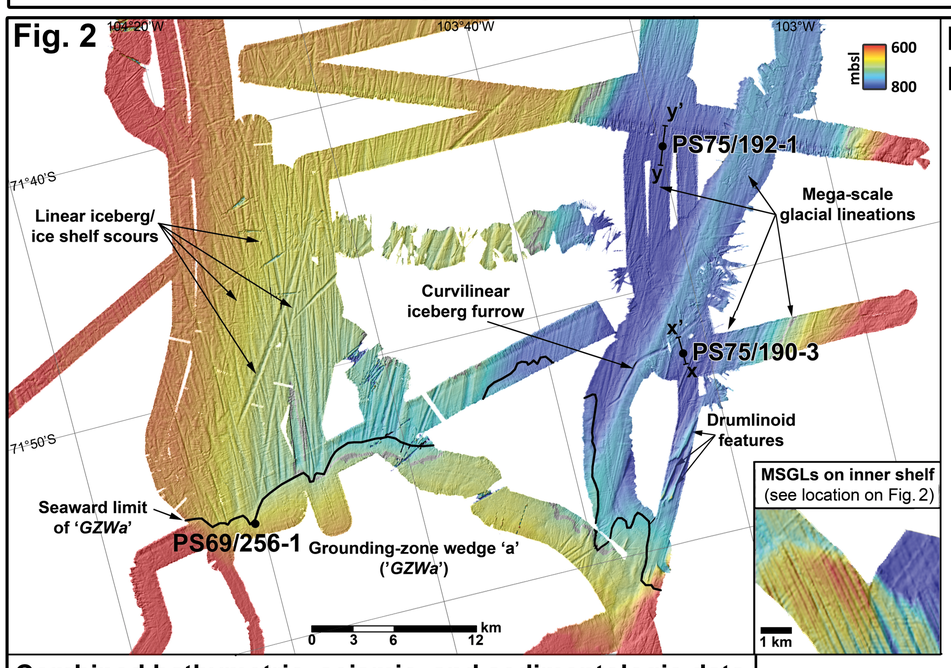
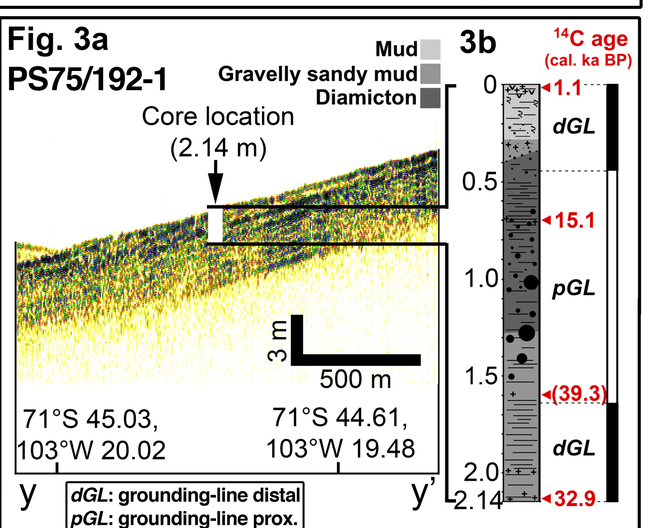
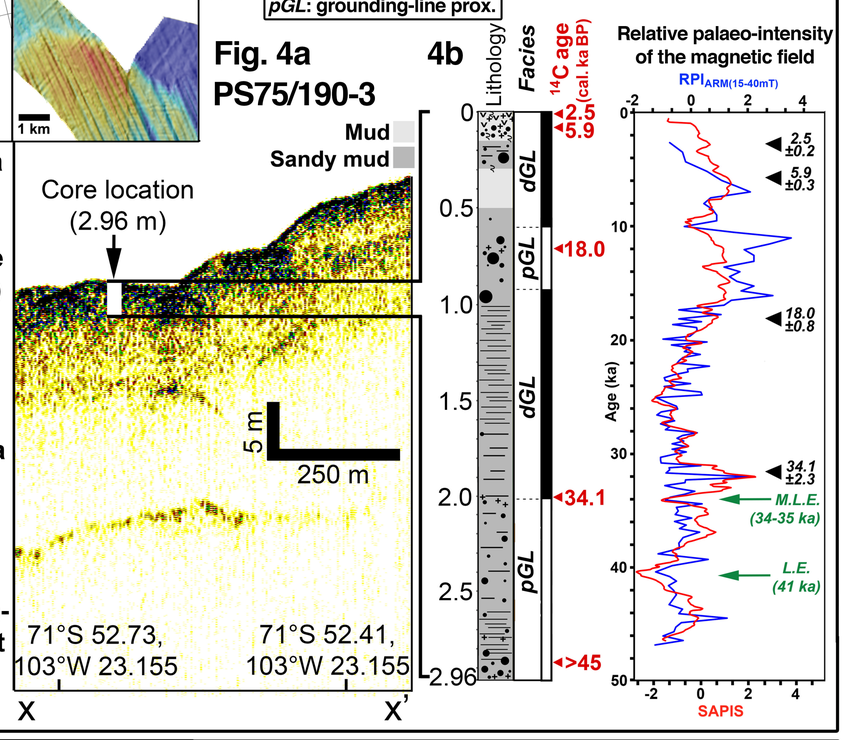
New details about the LGM extent and subsequent retreat of the West Antarctic Ice Sheet from the easternmost Amundsen Sea Embayment shelf

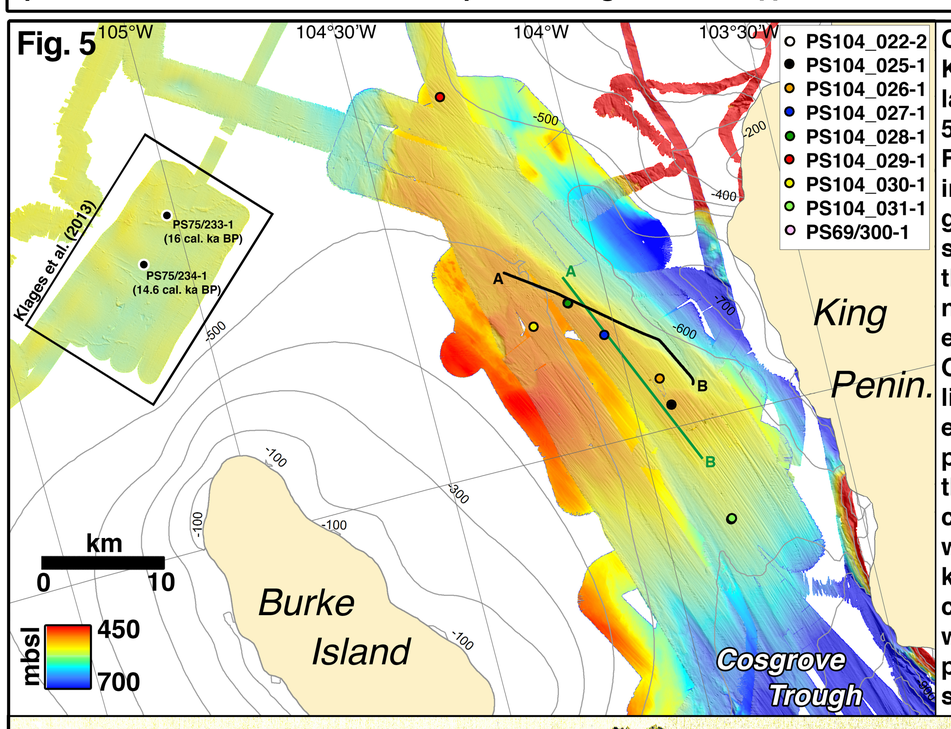
In recent years several previously undiscovered grounding-zone wedges (GZWs) have been described within the Cosgrove-Abbot palaeo-ice stream trough (CAT; Fig. 1) on the easternmost Amundsen Sea Embayment shelf. These GZWs document both the Last Glacial Maximum (LGM; 26.5-19 cal. ka BP) grounding-line extent and the subsequent episodic retreat within this trough that neighbors the larger Pine Island-Thwaites trough to the west. Here we combine bathymetric, seismic, and geologic data showing that 1) the grounding line in CAT did not reach the continental shelf break at any time during the last glacial period, and 2) a prominent stacked GZW constructed from at least six individual wedges lying upon another was deposited 100 km upstream from the LGM grounding-line position. The available data allow for calculating volumes for most of these individual GZWs and for the entire stack. Sediment cores were recovered seawards from the outermost GZW in the trough (Fig. 2), and from the individual wedges of the stacked GZW (Fig. 5) in order to define the LGM grounding-line extent, and provide minimum grounding-line retreat ages for the respective positions on the stacked GZW. We present implications of a grounded-ice free outer shelf throughout the last glacial period. Furthermore, we aim at assessing the significance of the grounding-line stillstand period recorded by the stacked GZW in CAT for the timing of post-LGM retreat of the West Antarctic Ice Sheet from the Amundsen Sea Embayment shelf.



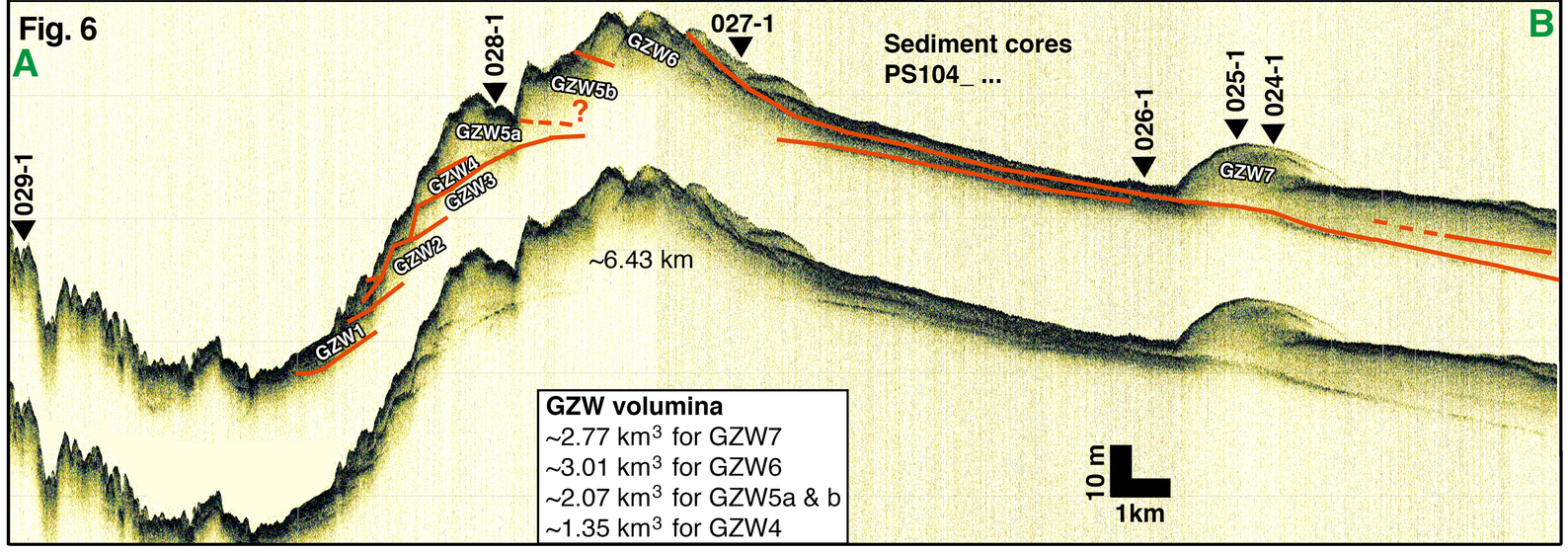


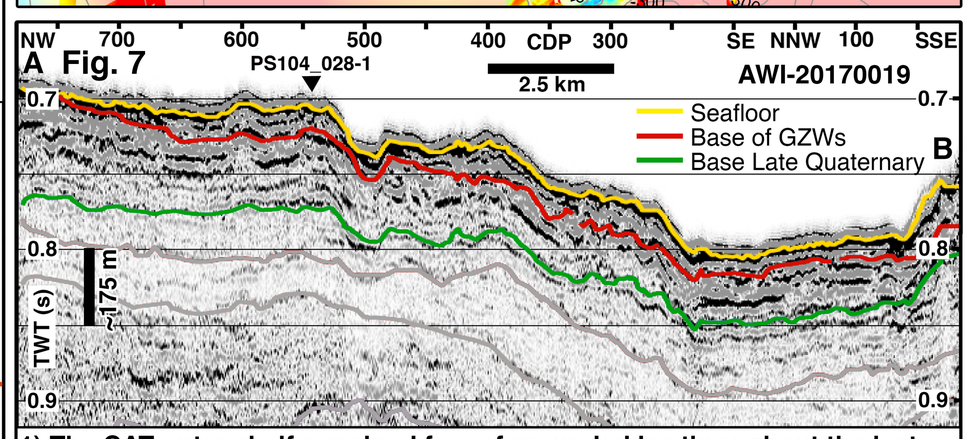






On the CAT middle shelf in between Burke Island and King Peninsula (Figs. 1,2), seven generations of overlapping GZWs were mapped over about 40 km (Figs. 5,6) during RV *Polarstern* Exp. PS104 in early 2017. First estimates of individual GZW volumes through integration of the different geophysical datasets are given in the inset box in Fig. 6. The base of the entire stack was imaged by reflection seismics indicated by the red line in Fig. 7. The data reveals a ~100 m thickness for the entire stack. Additionally, we recovered eight sediment cores, sampling most of the individual GZWs within the stack, which may allow us to establish age constraints for each grounding-line retreat episode (Figs. 5,6) but also for the entire stabilization period. Together with the estimated GZW volumes, the ages from sediment cores may also enable the calculation of sediment flux rates at grounding lines, which remain elusive for Antarctic shelf GZWs. This knowledge will help refine available post-LGM retreat chronologies for the Amundsen Sea Embayment, which, in turn, serve as a basis for validating and improving ice-sheet models in an area where precise simulations of future retreat are urgently needed.





1) The CAT outer shelf remained free of grounded ice throughout the last glacial period. This knowledge refines LGM ice-sheet reconstructions and adds to potential sites for glacial benthic shelf refugia. It further enables efforts for retrieving Last Interglacial West Antarctic shelf sediments here.
2) Age constraints on calcareous microfossils in 8 sediment cores along the stacked GZW will define halting periods for each wedge, and will reveal the significance of the entire stack for the timing of post-LGM ice-sheet retreat.

References

Klages, J.P., Kuhn, G., Graham, A.G.C., Hillenbrand, C.-D., Smith, J.A., Nitsche, F.O., Larter, R.D., Gohl, K., 2015. Palaeo-ice stream pathways and retreat style in the easternmost Amundsen Sea Embayment, West Antarctica, revealed by combined multibeam bathymetric and seismic data. Geomorphology 245, 207–222.

Klages, J.P., Kuhn, G., Hillenbrand, C.-D., Smith, J.A., Graham, A.G.C., Nitsche, F.O., Frederichs, T., Jernas, P.E., Gohl, K., Wacker, L., 2017. Limited grounding-line advance onto the West Antarctic continental shelf in the easternmost Amundsen Sea Embayment during the last glacial period. PLOS ONE 12(7), doi:10.1371/journal.pone.0181593.

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