A significant acceleration of ice volume discharge preceded a major retreat of a West Antarctic paleo–ice stream

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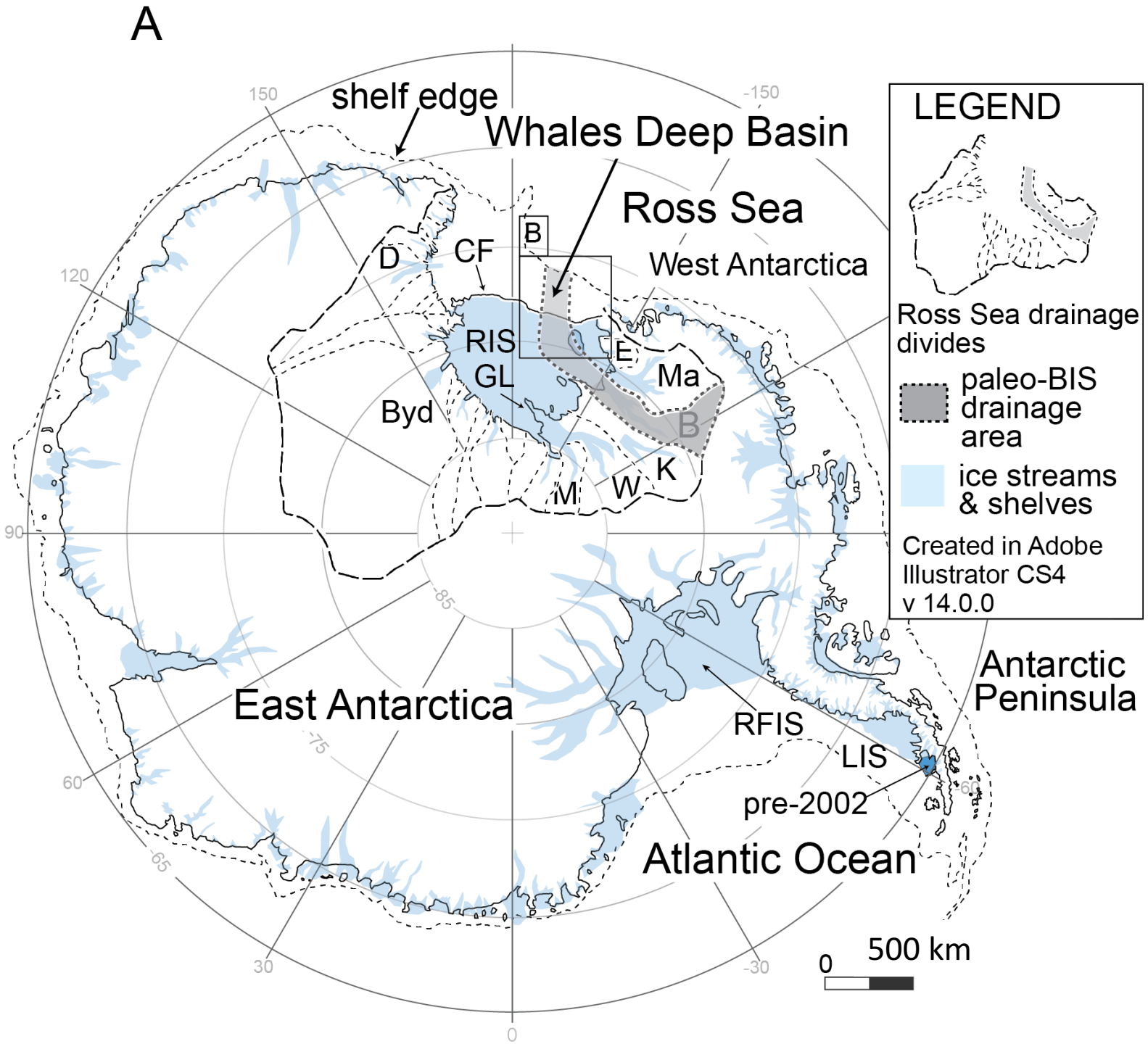
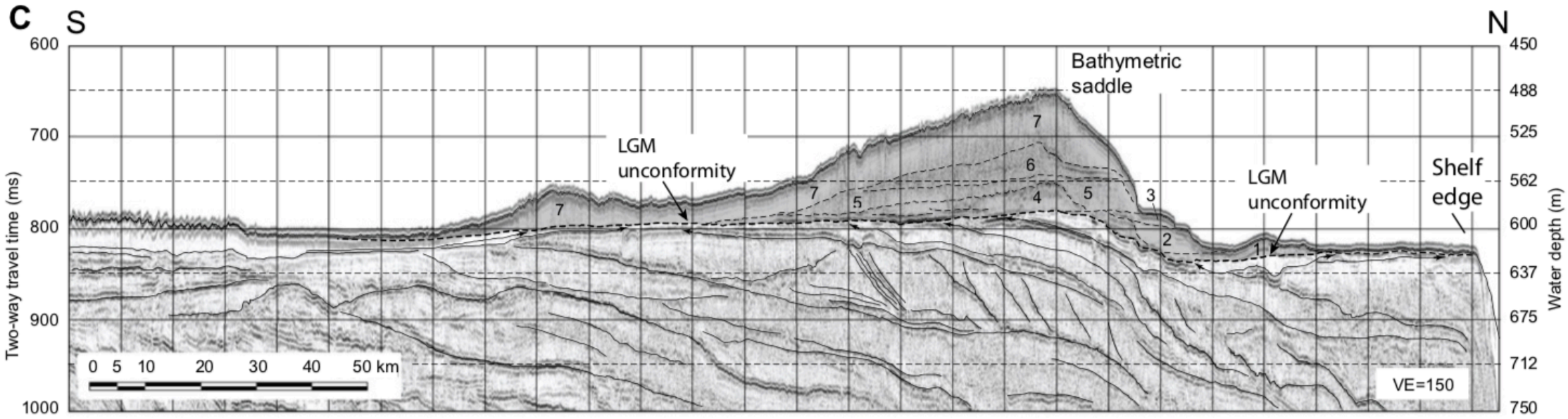
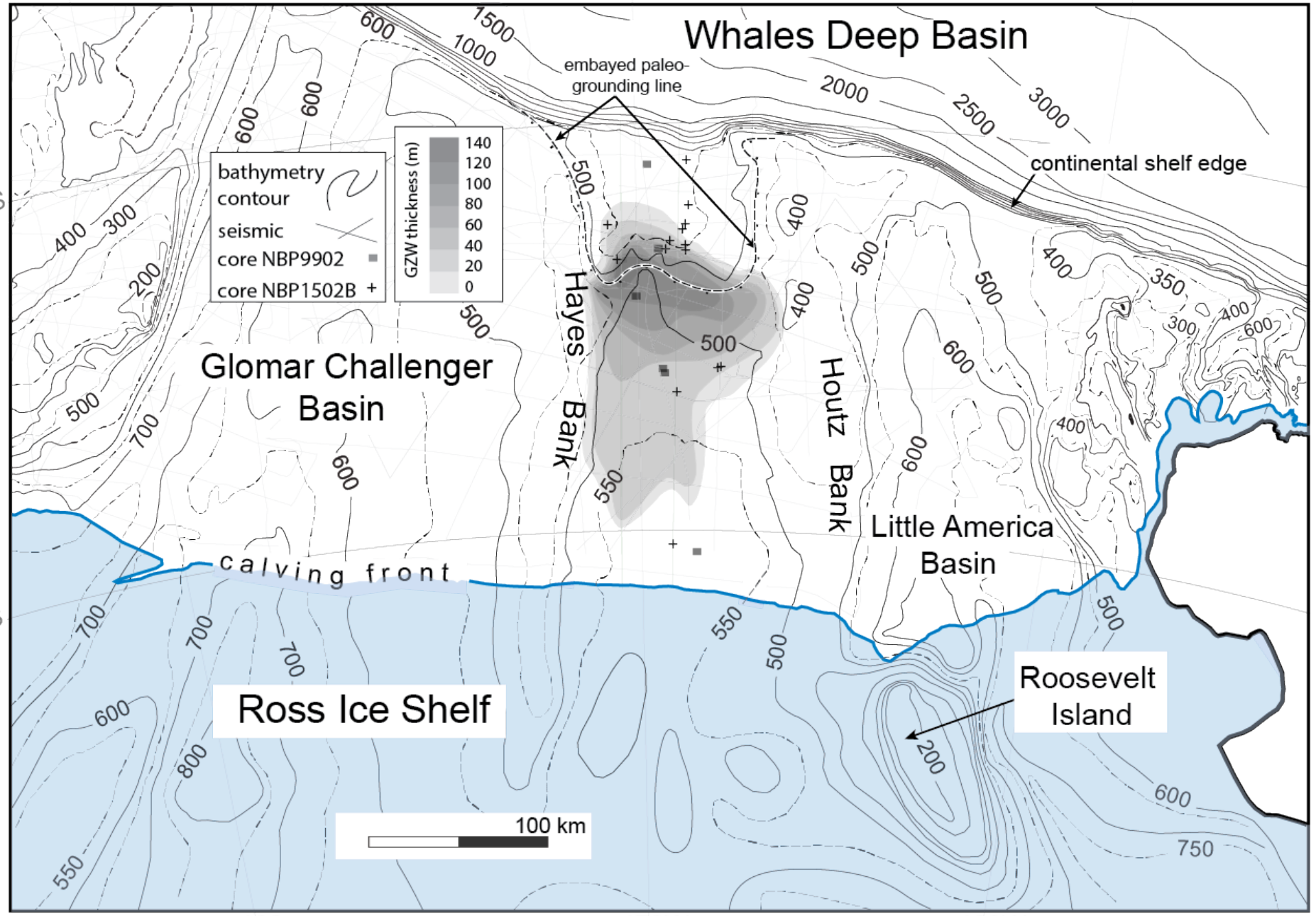


- The gray shade shows the extent of the Bindschadler Ice Stream (B) in the Whales Deep Basin on the eastern Ross Sea outer continental shelf during the LGM.



- This is a dip-oriented seismic line from the axis of the Whales Deep Basin. The southern end is near the modern calving front and the northern end extends to the shelf edge.
- Seismic correlations show that at least 7 grounding zone wedges (GZWs are labled 1 thru 7 from oldest to youngest) were deposited by the Bindschadler Ice Stream after it retreated from the continental shelf edge.
- The small ice shelf fronting the paleo-Bindschadler Ice Stream broke up at the end of GZW4 deposition.

B



- Here's an isopach map showing the total sediment volume of GZWs 1 thru 7.

TABLE 1. ESTIMATES OF SEDIMENT FLUX, YIELD, AND VELOCITY OF THE PALEO-BINDSCHADLER ICE STREAM, WEST ANTARCTICA

Whales Deep Basin grounding	Grounding-zone wedge volume ($\times 10^{11}$ m^3)	Grounding chronologies (cal. kyr B.P.)			Grounding duration (yr)	Paleo-BIS sediment flux (10^8 m^3 a^{-1})	Paleo- BIS drainage area ($\times 10^{11}$ m^2)	Estimated sediment yield (mm a^{-1})	Estimated paleo-BIS velocity (m a^{-1})
		Onset of OCS grounding	Paleo–ice-shelf breakup	End of OCS grounding					
Total	5.34	14.7 ± 0.4	12.3 ± 0.2	11.5 ± 0.3	3200 ± 700	1.7 ± 0.77	2.33	0.7 ± 0.21	500 ± 120
Pre-ISBU	1.60	14.7 ± 0.4	12.3 ± 0.2	—	2400 ± 400	0.67 ± 0.2	2.33	0.3 ± 0.1	200 ± 90
Post-ISBU	3.74	—	12.3 ± 0.2	11.5 ± 0.3	800 ± 300	4.7 ± 1.0	2.33	2.0 ± 0.4	1350 ± 580

Note: OCS—outer continental shelf; BIS—Bindschadler Ice Stream; ISBU—ice-shelf breakup. "Total" refers to deposits of grounding-zone wedges (GZWs) GZW1 through GZW7. Post-glacial sediment drape is not included in the quantification of GZW volume (see the Data Repository [see text footnote 1]). "Pre-ISBU" refers to deposits of GZW1 through GZW4. "Post-ISBU" refers to deposits of GZW5 through GZW7.

- Column 2, row 1 shows the total volume of GZW sediment.
- Column 1 rows 2 and 3 show our estimate of sediment deposited prior to and after the ice shelf break up (ISBU).
- Columns 3 and 4 show the chronology of the grounding stillstands and durations.
- From those data, we can calculate the paleo-BIS sediment flux (column 5).
- From the sediment flux, we can estimate paleo-BIS velocity (column 8).
- The paleo-BIS velocity averaged 500 ±120 m a^{-1} over the entire grounding but was 1350 ±580 m a^{-1} following the ice-shelf breakup at 12.3 ±0.2 kyr BP.
- The long-term average is close to the estimated balance velocity of the ice stream (580 ±100 m $a^{-1)}$, but the post-ISBU velocity implies an ~30 Gt a^{-1} mass imbalance just before the the paleo-BIS grounding line retreated >200 km.
- This case of paleo-ice stream retreat shortly after an ISBU substantiates the current concerns about a near-future rapid retreat of major glaciers in the Amundsen Sea sector (e.g., Pine Island Glacier and Thwaites Glacier).

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