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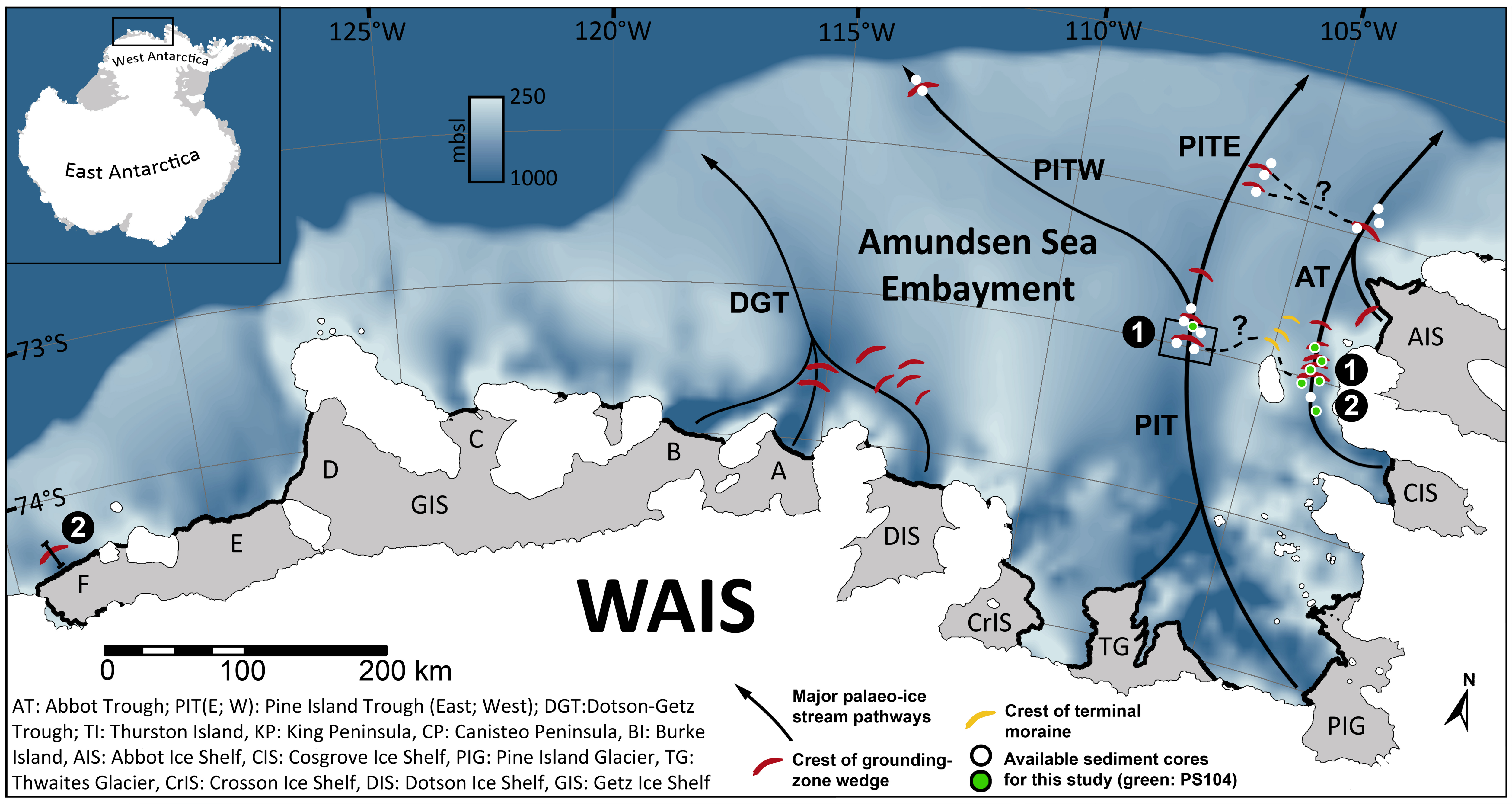
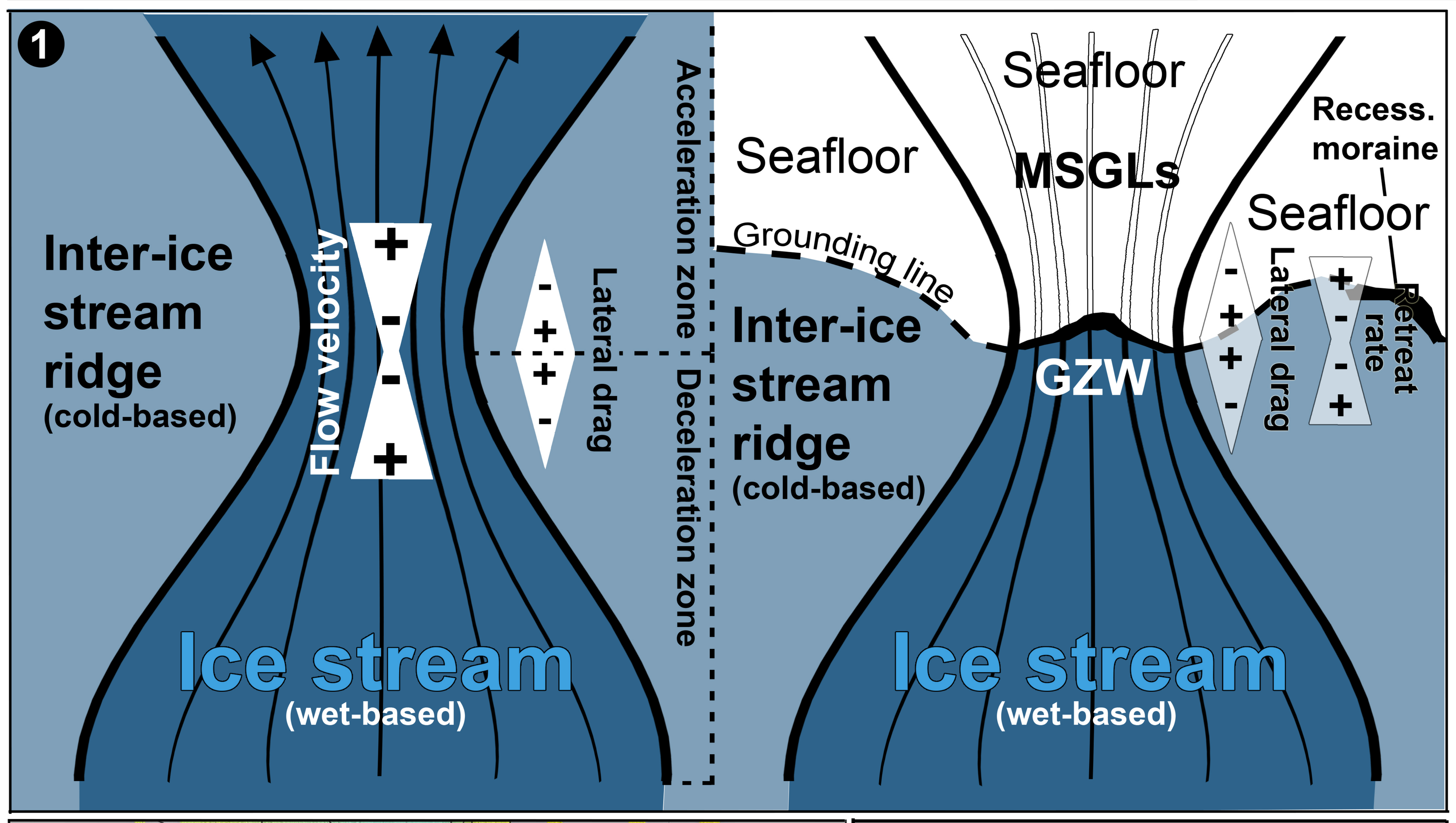
The grounding-zone wedge inventory on the Amundsen Sea Embayment shelf, West Antarctica: formation processes and significance for establishing reliable post-LGM retreat chronologies

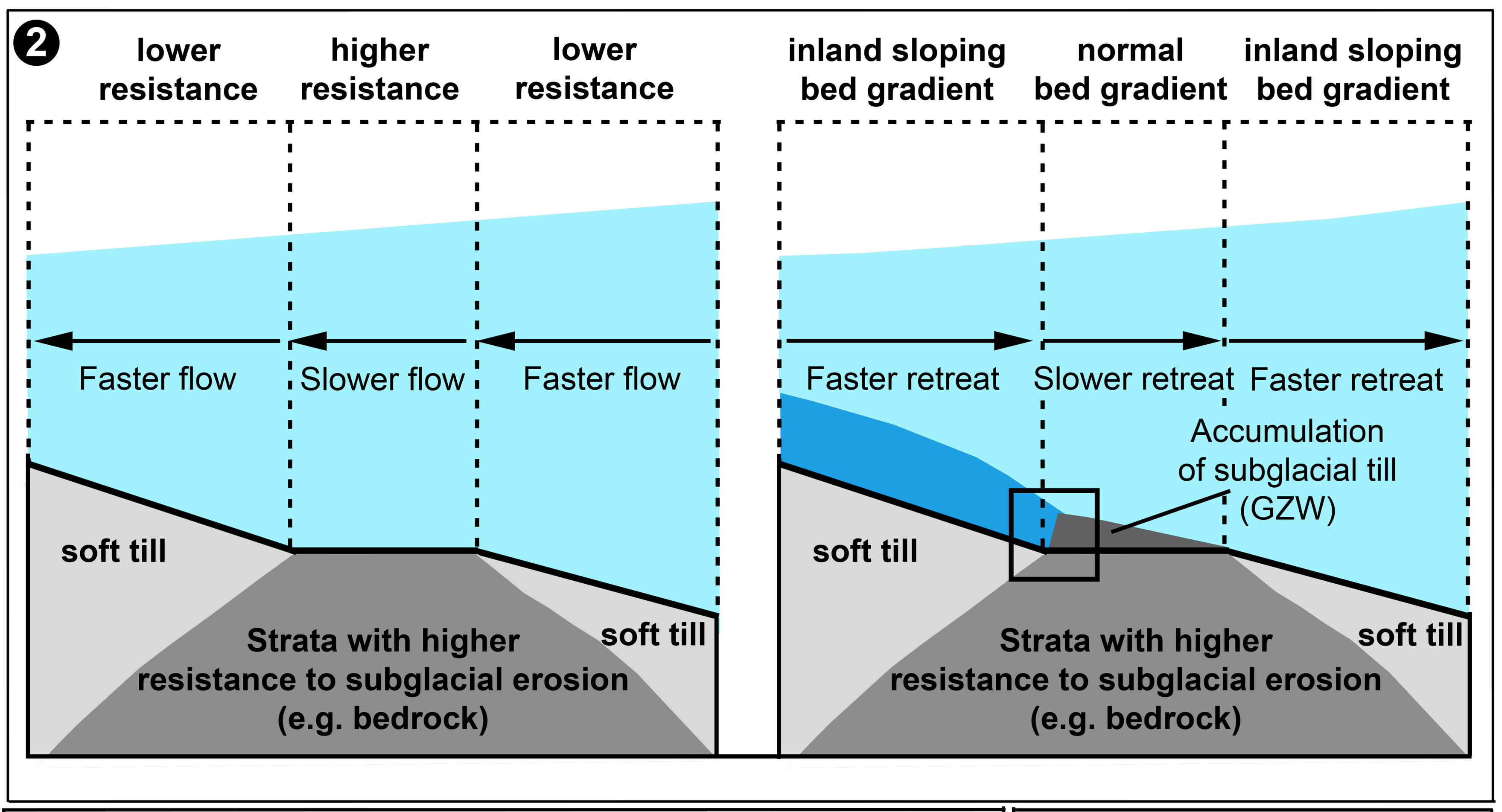
Grounding-zone wedge inventory

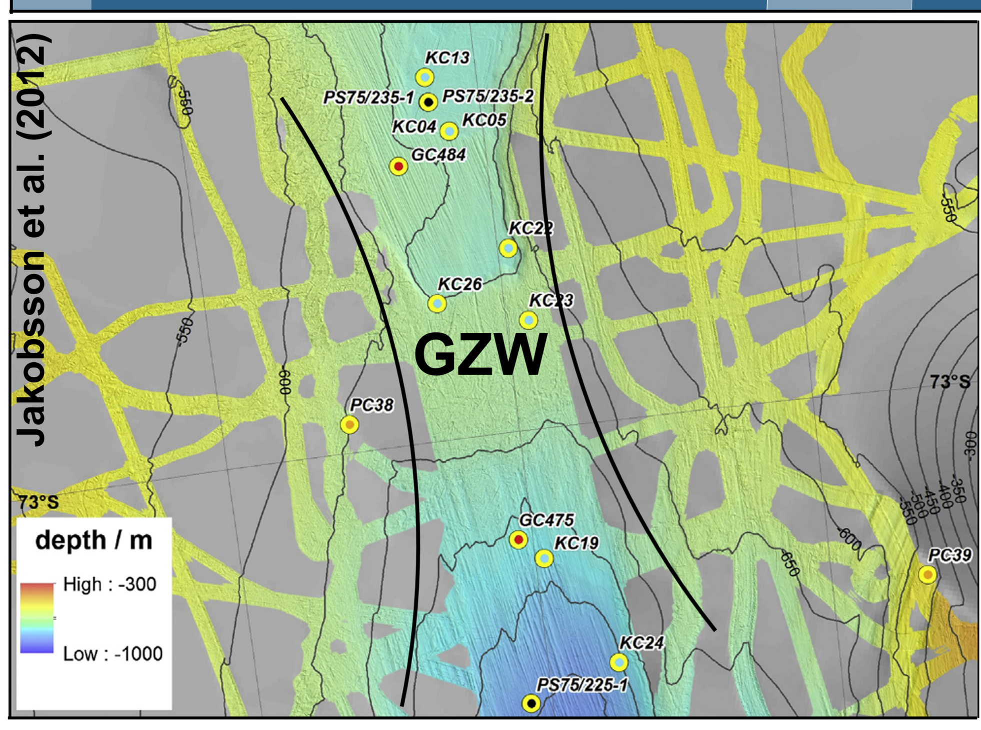


Grounding-zone wedges (GZW) have been mapped on many of the formerly glaciated continental shelves around Antarctica. These GZWs record periods of grounding-line (GL) stillstand during general ice-sheet retreat following the Last Glacial Maximum (LGM; 26-19 ka BP; kiloyears before present). The presence of GZWs along the axis of a palaeo-ice stream trough therefore indicates a style of episodic GL retreat during the migration from its initial position at the LGM to its modern position. However, precise chronological constraints for both the onset and duration of these stillstands are still lacking. Consequently, the role of GZW formation in modulating post-LGM ice-sheet retreat, and therefore ice-sheet stability cannot be reliably quantified. Additionally, this information is also vital for calculating reliable retreat rates during the past, which are essential for evaluating and understanding the significance of modern, locally very high retreat rates of glaciers draining into the Amundsen Sea Embayment.

Formation processes

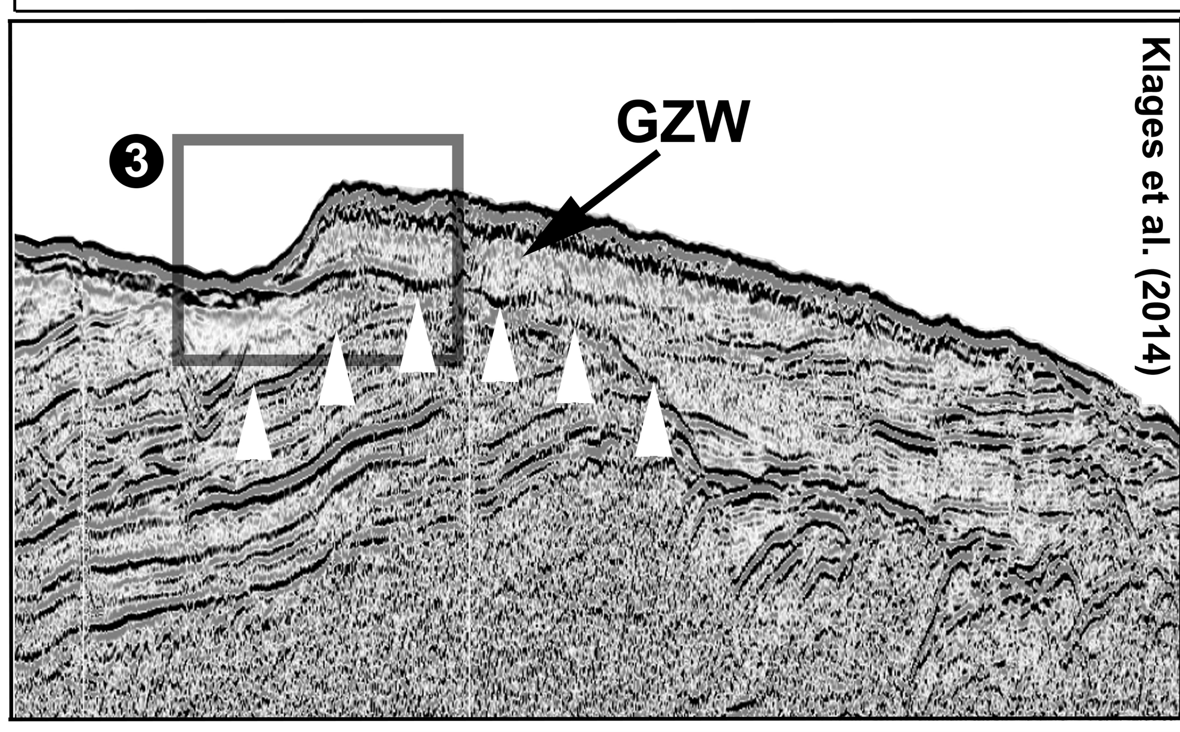






'Bottle neck'-topography

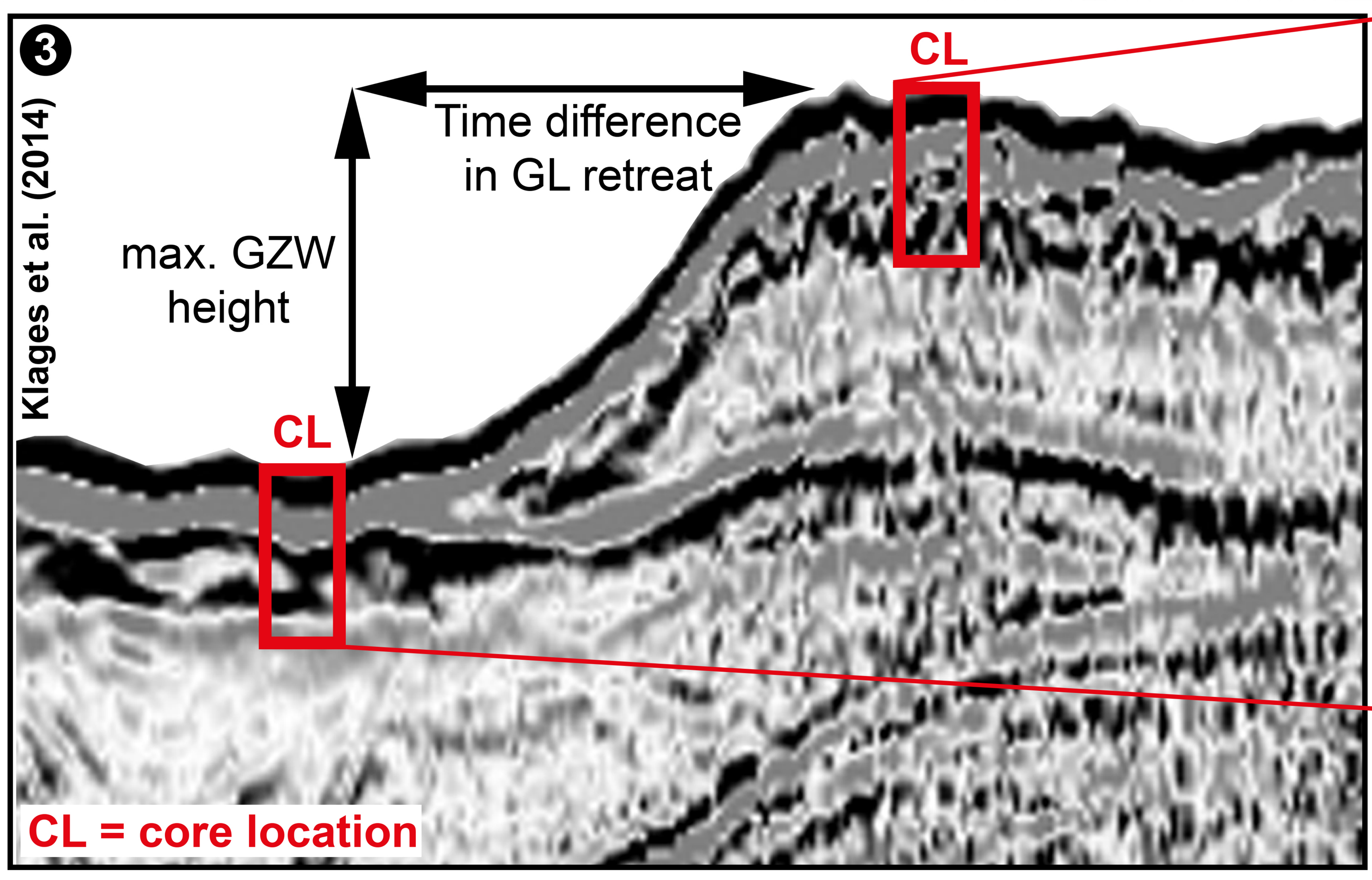
The trough geometry narrows in downstream direction and leads to a deceleration of the ice flow velocity during full-glacial conditions. The GL retreats slower through the "bottle-neck" and thus accumulates subglacial till over a longer period of time. The subsequent till accumulation 'produces' a normal bed gradient, and may in turn further stabilize the ice sheet's GL.

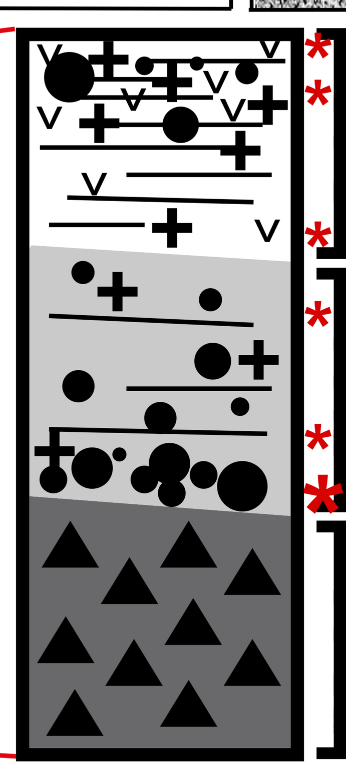


Subglacial geology

Old and hard (sometimes lithified) strata with a higher resistance to subglacial erosion crops out at the ice sheet base and likely decreased the ice flow velocity. During retreat the 'normal' bed gradient of the resistant material (arrows) leads to slower grounding-line retreat and caused *in-situ* accumulation of till.

Timing of GL halts





The sediment cores for this study were retrieved with the research vessels *Polarstern* (PS69, PS75 & PS104), *James C. Ross* (JR141 & JR179) and *Oden* (OSO0910). Dating calcareous microfossils from (preferably) the base of the 'proximal GL'-facies in cores from directly seaward the GZW and from its crest (see left figure) should give reliable ages for the respective GL retreat from each location. The time period in between the two ages should be largely equivalent to the duration of GL stabilization in this position, which in turn led to the build-up of the GZW. Quantifying this would constrain the time impact of ice stream controlling factors such as topography and geology for steering the retreat behaviour of ice streams.

*Sample locations for micro-^{14}C

Massive diamicton | Gravelly sandy mud | Ice Rafted Debris | Stratified diamicton | Stratification | Forams / Diatoms

Conclusions: This knowledge will help refine available post-LGM retreat chronologies which, in turn, serve as a basis for a better calibration of ice-sheet models.

References:
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