

ICEBERG ALLEY – ANTARCTIC GATEWAY TO LOWER LATITUDES

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To understand the natural sea-level rise during the last deglaciation is a key to understand current and future climate change. Here, the role of the Antarctic Ice Sheet is poorly understood, yet crucial because ice-sheet collapse in a warming world could cause rapid sea-level rise. We developed a chronology for the Weddell Sea sector of the East Antarctic ice sheet (EAIS) that, combined with ages from other Antarctic ice-sheets, indicates that the advance to (at 29 –28 ka) and retreat from their maximum extent (at 19 ka, and again, at 16 ka) was nearly synchronous with Northern Hemisphere ice sheets (Weber, M.E., Clark, P. U., Ricken, W., Mitrovica, J. X., Hostetler, S. W., and Kuhn, G. (2011): Interhemispheric ice-sheet synchronicity during the Last Glacial Maximum. – *Science*, 334, 1265-1269, doi: 10.1126/science.1209299).

Using an atmospheric general circulation model we conclude that surface climate forcing of Antarctic ice mass balance would likely cause an opposite response, whereby a warming climate would increase accumulation but not surface melting. Furthermore, our new data support teleconnections involving a sea-level fingerprint forced from Northern Hemisphere ice sheets as indicated by gravitational modeling. Also, changes in North Atlantic Deepwater formation and attendant heat flux to Antarctic grounding lines may have contributed to synchronizing the hemispheric ice sheets.

Recent data from two well-dated deep-sea sites from the Scotia Sea (Weber, M.E., Kuhn, G., Sprenk, D., Rolf, C., Ohlwein, C., and Ricken, W. (2012): Dust transport from Patagonia to Antarctica – a new stratigraphic approach from the Scotia Sea and its implications for the last glacial cycle. – *Quaternary Science Reviews*, 36, 177-188,

doi: 10.1016/j.quascirev.2012.01.016) provide the first integrative and representative record of Antarctic Ice Sheet instability. These sites, located in the central transport route of virtually all Antarctic icebergs, the so-called Iceberg Alley, demonstrate a highly dynamic Antarctic Ice Sheet during the last deglaciation with eight distinct phases of enhanced iceberg routing, dubbed Antarctic Ice Sheet Events (AIE), in contrast to existing models of a late and monotonous ice-sheet retreat with little contribution to the last, natural, sea-level rise 19,000 to 9,000 years ago. We found the first direct evidence for an Antarctic contribution to Meltwater Pulse 1A in the flux rates of ice-rafted debris.

Using an ensemble of transient deglacial model simulations we could show that increased export of warmer Circumpolar Deep Water towards Antarctica contributed to Antarctic Ice Sheet melt by ocean thermal forcing (Weber, M. E., Clark, P. U., Kuhn, G., Timmermann, A., Sprenk, D., Gladstone, R., Zhang, X., Lohmann, G., Menviel, L., Chikamoto, M., Friedrich, T., submitted: Millennial-scale variability of the Antarctic Ice Sheet throughout the last deglaciation. – *Science*, under review). These new findings hold the potential to substantially revise and improve our understanding of the transient response of the ice sheet to external and internal forcings, and the contributions to the postglacial isostatic adjustment as well as to the last, natural, sea-level rise. Our results will also help improving projections of future sea-level rise by implementing enhanced ocean thermal forcing.