Evolution of the Antarctic ice sheet

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ULB study sheds a new light on the stability of the Antarctic ice sheet. It shows for the first time that ice rises (pinning points that keep the floating parts of ice sheets in place) are formed during the transition between glacial and interglacial periods, which significantly slows down the response of the ice sheet to climate change.

The Antarctic ice sheet holds as much ice to potentially raise global sea level with 67 meter. Many questions still arise regarding its reaction to climate change, especially for the marine sections of the ice sheet. The contact of the ice sheet with the ocean happens through the formation of ice shelves, which are large sections of floating ice flowing down from the continental ice sheet. Recent observations show that these large shelves are thinning rapidly. Ice shelves can be seen as the cork on a wine bottle lying flat. Removing the cork will lead to the bottle emptying. Therefore, thinning or removing ice shelves make more continental ice to discharge into the ocean, leading to sea level rise. Ice shelves are held in place by contact with embayments and pinning points at the bed. Thinning reduces this contact and reduces the stress that keeps the continental ice normally stable.

For the first time, Dr. Lionel Favier and Prof. Frank Pattyn from the Laboratoire de Glaciologie, Faculty of Sciences of the Université libre de Bruxelles (ULB) in Belgium demonstrate how such pinning points (which form ice rises in the ice shelf, or locally grounded small ice caps within ice shelves) are formed and how they keep ice shelves stable. Ice rises are omnipresent along most of the Antarctic coast and believed to buttress ice shelves to keep them stable. Using a sophisticated ice-sheet

model, Favier and Pattyn show that these ice rises actually formed during the deglaciation of the ice sheet, when the grounding line (contact between ice sheet and ice shelf) retreats over the continental shelf. Their major impact during this retreat is that ice rises, once formed, significantly slow down this retreat, which may explain why major changes in ice volume in the past often show a delayed response to climate change.

Favier: "It is amazing to see how a relatively small feature, such as an ice rise, can delay the retreat of a continental ice sheet during a deglaciation by several thousands of years. This understanding is possible thanks to the recent tremendous effort of the glaciological community to improve ice-sheet models".

Pattyn: "This study sheds a new light on how we think about ice sheet evolution. Ice rises not only influence the stability of ice shelves, but also influence their formation. This insight will help to better constrain future evolution of ice sheets and their contribution to sea level rise".

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More information: "Antarctic ice rise formation, evolution and stability." *Geophysical Research Letters*. DOI: 10.1002/2015GL064195

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