

Glaciology of the Bottleneck

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The Bottleneck (60 W to 135 W, 86 S) is the narrow neck joining grounded portions of the East and West Antarctic Ice Sheets. In two wide gaps in the Transantarctic Mountains, separated by Thiel Mountains, ice up to 2500 m high and 3000 m thick spans the Bottleneck, with East Antarctic ice drained by Foundation Ice Stream into Filchner-Ronne Ice Shelf and by Mercer Ice Stream into Ross Ice Shelf. These ice shelves formed after gravitational collapse of the West Antarctic Ice Sheet beginning 6000 years ago to create large embayments in the Weddell Sea and Ross Sea. During collapse ice entered these embayments from three sides, east, west, and south, and left from one side, north. Today, ice leaves the remaining West Antarctic Ice Sheet from three sides, east, west, and north, and enters from one side, south. That entrance is the Bottleneck. It seems possible, therefore, that the remaining third of the ice sheet can collapse much faster than first two thirds, in 1000 years or perhaps much sooner.

Collapse of the remaining third of the grounded West Antarctic Ice Sheet would produce a similar large embayment in the Amundsen Sea, with collapse already having begun to form Pine Island Bay, which would widen toward the Bottleneck as downdrawn retreat of Pine Island Glacier and Thwaites Glacier continues. Retreat could continue through the Bottleneck into East Antarctica, with Pine Island Glacier and Foundation Ice Stream joining to pass east of Thiel Mountains and Thwaites Glacier and Mercer Ice Stream joining to pass west of Thiel Mountains. This would expose the heart of the East Antarctic Ice Sheet to rapid gravitational collapse, just as the heart of the Laurentide Ice Sheet collapsed 8000 years ago after a downdrawn ice stream retreated up Hudson Strait into Hudson Bay.

Two sectors of the East Antarctic Ice Sheet have already been downdrawn by major ice streams. At the grounding line of Byrd Glacier with Ross Ice Shelf, East Antarctic ice is 1000 m lower today than formerly. At the grounding line of Lambert Glacier with Amery Ice Shelf, East Antarctic ice is 3000 m lower. Both ice streams have drainage basins in East Antarctica that are as large as the remaining grounded West Antarctic Ice Sheet. Ongoing gravitational collapse of the West Antarctic Ice Sheet "pulls the plug" in the Bottleneck and opens a flood of East Antarctic ice into a new Amundsen Sea Embayment that may dwarf the 5 to 6 meters of sea level now locked up in West Antarctica.