Largest ice shelf in Antarctica lurches forward once or twice each day

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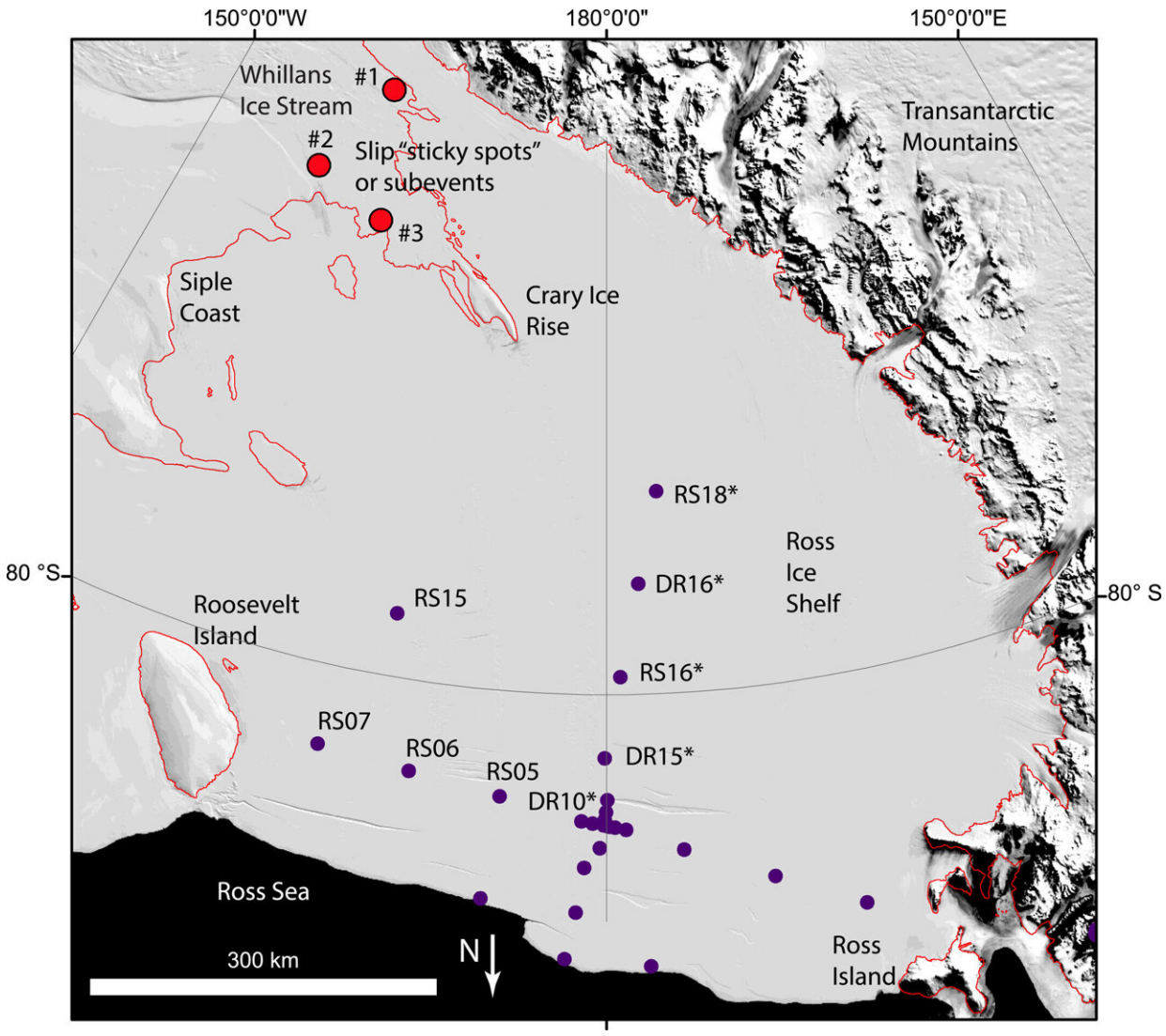

Geography of the Ross Ice Shelf region with seismic stations shown as blue circles. Seismic stations used in this study are labeled, with sites also equipped

with Global Navigation Satellite System receivers denoted by asterisks. The grounding line, denoted by a red line, and the background image are from Scambos et al. (2007). The locations of Whillans Ice Stream slip asperities (Pratt et al., 2014) are shown as red circles. Credit: *Geophysical Research Letters* (2024). DOI: 10.1029/2023GL108040

In Antarctica, heavy glaciers are always on the move. Conveyor belts of ice, known as ice streams, are the corridors of faster flow that carry most of the vast glaciers' ice and sediment debris out toward the ocean.

One such ice stream jostles the entire Ross Ice Shelf out of place at least once daily, according to new research from Washington University in St. Louis.

This finding is significant because of the scale of the Ross Ice Shelf: It is the largest ice shelf in Antarctica, about the same size as the country of France.

"We found that the whole shelf suddenly moves about 6 to 8 centimeters (or 3 inches) once or twice a day, triggered by a slip on an ice stream that flows into the ice shelf," said Doug Wiens, the Robert S. Brookings Distinguished Professor of earth, environmental and planetary sciences in Arts & Sciences. "These sudden movements could potentially play a role in triggering icequakes and fractures in the ice shelf."

The Ross Ice Shelf is a floating lip of ice that extends out over the ocean from inland glaciers.

Scientists are interested in interactions between ice shelves and ice streams in part because they are concerned about the stability of Antarctica's ice shelves in a warming world.

Ice shelves act as brakes for glaciers and ice streams, slowing their journey to the sea where they melt, thus allowing more ice to accumulate on the continent. If an ice shelf collapses, this support disappears, and the glaciers are free to flow faster. Once they flow into the ocean, they contribute to sea level rise.

The new study, in *Geophysical Research Letters*, focuses on movement triggered by the Whillans Ice Stream, one of about a half-dozen of the large, fast-moving rivers of ice pouring into the Ross Ice Shelf.

"One would not detect the movement just by feeling it," Wiens said. "The movement occurs over a time period of several minutes, so it is not perceptible without instrumentation. That's why the movement has not been detected until now, even though people have been walking and camping on the Ross Ice Shelf since the time of the great explorers Robert F. Scott and Roald Amundsen."

Sudden slipping

The movement of the Ross Ice Shelf is triggered by a relatively sudden—in glacial terms—movement of the ice stream called a slip event. It is somewhat similar to the "stick-slip" that occurs along a fault before and during an earthquake.

Under the scenario that Wiens and his team observed, a large section of the Whillans Ice Stream, measuring more than 100 km by 100 km, remains stationary while the rest of the ice stream creeps forward. Then, once or twice per day, the large section lurches forward against the Ross Ice Shelf.

It can move as much as 40 cm (16 inches) in a few minutes, Wiens said.

Studies of ice streams over the past 50 years show some ice streams

speeding up and others slowing down. Scientists can use seismographs to detect the sudden motion of the ice streams to help understand what controls this motion. Wiens and his team traveled to Antarctica in 2014 to place the seismographs used in this study.

"I've published several papers about the Whillans Ice Stream slip events in the past but had not discovered that the whole Ross Ice Shelf also moves until now," Wiens said.

The researchers do not think that these slip events are directly related to human-caused global warming. One theory is that they are caused by the loss of water in the bed of the Whillans Ice Stream, making it more "sticky."

The stress and strains associated with slip events are similar to the stress and strain observed to trigger icequakes under different conditions.

"At this point, icequakes and fractures are just part of the normal life of the ice shelf," Wiens said. "There is a worry that the Ross Ice Shelf will someday disintegrate since other smaller and thinner ice shelves have done so. We also know that the Ross Ice Shelf disintegrated during the last interglacial period—about 120,000 years ago—and that caused rapid ice loss to the other glaciers and ice streams feeding into it."

More information: Douglas A. Wiens et al, Ross Ice Shelf Displacement and Elastic Plate Waves Induced by Whillans Ice Stream Slip Events, *Geophysical Research Letters* (2024). DOI: 10.1029/2023GL108040

Provided by Washington University in St. Louis