Making the Paper: Joanne Johnson

Exposed boulders on the harsh terrain of west Antarctica harbour a warning that the region's glaciers could collapse.

Joanne Johnson's first chance to explore the fastest-melting glaciers of the West Antarctic Ice Sheet came unexpectedly, nearly two years ahead of schedule. But it was also overdue.

Satellite data and ground-based measurements had raised alarms that fast-flowing glaciers near Pine Island Bay could disintegrate completely, raising global sea levels by a metre. Yet Johnson, whose work has now validated concerns that the glaciers there are melting rapidly, was the first to set foot on the region's rocky bluffs in four decades.

The trip represented not only a challenge for Johnson, a geologist with the British Antarctic Survey (BAS), but a change in her scientific direction. Previously, while working on ancient volcanoes, she had set out by foot from field camps to collect rocks from the relatively placid northern Antarctic Peninsula. But now she found herself in search of large granite boulders in one of the continent's most remote and punishing regions. Far from any research base, on terrain scoured by winds and guarded by capriciously shifting sea ice, Johnson was looking for chemical clues in rocks left behind by glaciers that had melted over the past several millennia.

The crucial clues were beryllium-10 and certain other isotopes, formed in the granite when boulder-bearing glacial currents shrank back from mountaintops and left the rocks high and dry — and exposed to cosmic rays from space. As the isotopes accumulate over time in ice-free rock, they provide a measure of when — and how quickly — the glaciers thinned. Lacking that historic perspective, scientists couldn't be sure that the melting seen today is much different from the ice sheets' past behaviour.

Joanne Johnson in the Antarctic.

Johnson's demanding journey began when she joined a German icebreaker bound for Pine Island Bay in 2006, ahead of her planned 2007–2008 field trip with BAS. Sailing aboard the RV Polarstern, she was, among 100 scientists and crew, one of four who spoke no German. It was easier to circumvent the language barrier, however, than the sea ice. Once the ship managed to manoeuvre close to the glaciers, Johnson and her field assistant would strike out by helicopter in search of bedrock outcrops dotted with lumps of pinkish granite. She planned landing sites in advance, but "When you get there, you look at it and you think, it's too steep or too icy, we can't land here — then you have to start making decisions," she recalls.

Having made it to the ground, they fought winds that limited their ability to collect data, and sometimes even to stand upright. One area reached with difficulty had to be abandoned suddenly when the wind changed and ice began to close in behind the waiting ship. Meanwhile, the metre-wide boulders whose surfaces Johnson expected to sample were nowhere to be found. Instead, she scooped up six football-sized substitutes. "Here," says Johnson, "you grab what you can."

The recently published analyses (*Geology* **36,** 223–226; 2008) show that the glaciers have been thinning for at least 14.5 thousand years at approximately 2.3–3.8 centimetres per year, on average. Contrasted with the 1.6-metre-per-year deglaciation detected by satellite from 1992 to 1996, Johnson's results support fears that global warming is pushing the glaciers toward collapse. The sparse initial measurements will be filled in by forthcoming data, including some from Johnson's colleagues, who have just returned to find the sea ice much tamer.

After five years of virtually impassable sea ice in Pine Island Bay, says Johnson, "Ironically, at the moment it's quite open."

Anna Barnett is assistant editor and copy editor of Nature Reports Climate Change.