# Ice core 'dipstick' indicates West Antarctic ice has thinned less than believed

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Rising sea levels 20,000 years ago, as the last ice age was beginning to wane, often are attributed in part to melting in West Antarctica. But in a new study led by University of Washington researchers, an ice core of 1,000 meters was used as a sort of dipstick to show that a key section of the West Antarctic Ice Sheet probably never contained as much ice as scientists originally thought it did. That means it couldn't have contributed as much to the higher sea level.

In an area called Siple Dome, the ice sheet currently rises 1,000 meters -- more than half a mile -- above a bedrock plateau. Some computer reconstructions indicate it was perhaps twice as thick at the end of the last ice age, also called the Last Glacial Maximum.

But evidence from an ice core extracted near Siple Dome from 1997-99, along with other calculations, indicates ice in that area has lost only 200 to 400 meters of its thickness in the last 20,000 years, said Edwin Waddington, a UW professor of Earth and space sciences.

Like water on a hillside, Siple Dome ice flows down into adjacent ice streams, where it continues to the nearby Ross Ice Shelf, a part of a bay on the Ross Sea that is covered with floating glacier ice.

"Then the whole thing spreads out like oil on water," Waddington said.

The West Antarctic Ice Sheet once rested on the bottom of the bay all the way to its "grounding line" at the continental margin in the Ross Sea.

However, that ice has retreated substantially in the last 20 millennia, at the same time Siple Dome was thinning. Part of the puzzle has been whether the ice streams were flowing, whether they carried interior ice to the ice shelf at the end of the last ice age, and whether they began where they do now or receded along with the ice shelf's grounding line.

Studying the ice core layer by layer, each representing one year's worth of snowfall compacted into a very thin band, researchers were able to extract an isotope record that provided a picture of temperature and snowfall patterns near Siple Dome. The layers get thinner and thinner with depth, as more ice and snow piles up. But the thinness of the layers deposited near the end of the Last Glacial Maximum indicate the ice also was being thinned by ice streams that were flowing even then, probably starting in about the same places they do now.

"If you are making the ice sheet thinner over time, you're also stretching it much farther, so the individual layers get much thinner than they would be in a steady state," Waddington said.

Waddington is lead author of a paper describing the research, which is being published online March 23 in Geology, a journal of the Geological Society of America. Co-authors are Howard Conway and Eric Steig of the UW; Richard Alley of Pennsylvania State University; Edward Brook of Oregon State University; Kendrick Taylor of the Desert Research Institute at the University of Nevada, Reno; and James White of the University of Colorado. The work was funded by the National Science Foundation.

Previous data have shown that, in the ice age, glacial ice built to quite high elevations in the mountains just inland from the Ross Ice Shelf. That led to the expectation that Siple Dome had to be substantially thicker than it is now as the ice moved from the mountains to the ice shelf. But the new study shows the ice could not be thick at Siple dome,

so ice must have flowed toward the ocean with a very gentle slope for more than 600 miles. An ice sheet with such a low profile and gradual decline would have had to have a very slippery bed to maintain its continuous flow, Waddington said, and it appears the ice flowed vigorously despite being relatively thin.

One major implication of the research, he said, is that it disputes the theory that West Antarctic ice streams retreated when the ice shelf did. In the last ice age, the ice streams near Siple Dome had to be roughly where they are now to keep the dome from building up more ice.

By giving a clearer picture of the site where snow was deposited and eventually turned to glacial ice, the work gives scientists new information for interpreting climate in the last ice age and since, which is key to understanding how climate is changing today, Waddington said.

"To make climate judgments based on the past requires knowing the past climate accurately," he said.

Source: University of Washington