Research team uses innovative techniques to map water beneath Antarctic ice shelf

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(Phys.org)—Antarctica's recent summer season was a success for the Penn State researchers who camped out on the ice for nearly two months. Their efforts are part of a National Science Foundation-funded project to better understand melting that is happening on the Pine Island Glacier ice shelf, an extension of the Antarctic ice sheet. The Penn State team is in charge of mapping the ocean cavity beneath the ice shelf.

The weather cooperated in December and early January, giving Penn State graduate student Kiya Riverman and research associate Leo Peters the opportunity to use several methods to generate the images needed to

create an accurate model of the ocean circulation. "We were able to collect more than enough data to produce a meaningful map of the ocean cavity and ice thickness variations," Riverman said.

Riverman and Peters are working with Professor of Geosciences Sridhar Anandakrishnan, a lead researcher on the Pine Island Glacier project, which is an international effort that also receives support from NASA and includes researchers from the Naval Postgraduate School, the British Antarctic Survey, University of Alaska and New York University.

Water circulates under the Pine Island Glacier ice shelf, which is a floating extension of the Antarctic ice sheet. The Penn State team's part of the project is developing a map of that cavity beneath the 37-mile-long shelf. The images of ocean circulation will be used to fine tune models of future melting behavior and understand the role of rising ocean temperatures that are believed to be contributing to the melting of the ice shelf.

An aerial view of the Pine Island Glacier camp. Credit: Kiya Riverman

"Changes in the size of this ice shelf are a direct control on the speed of the glacier, which in turn is able to draw ice from a large portion of West Antarctica," Riverman said. "This means that changes on the Pine Island Ice Shelf have ramifications for much of Western Antarctica."

The site of the work is 1,200 miles from McMurdo Station on Antarctica and can be reached only by special planes that can land on ice. Riverman and Peters used reflection seismology to generate an image of the seafloor and ice-penetrating radar to map changes in ice thickness.

For the first of these techniques, the team pounded sledgehammers against steel plates and set off explosives to create energy on the surface of the ice.

"This energy travels through the ice and seawater and bounces off the seafloor," Riverman explained. "Using instruments called geophones, we record vibrations in the ice at the surface and the amount of time it takes for that energy to bounce off the seafloor. This tells us the seafloor depth. By repeating explosions or hammer blows at different locations, we can start to develop a map of the seafloor."

For the second technique, the team dragged a low-frequency radar unit behind a snowmobile to map changes in the thickness of the ice.

The NSF recently singled out the Pine Island Glacier project is one of three Antarctic science initiatives that have achieved technological milestones with innovative approaches to drilling.

"Although additional challenges doubtless lie ahead for these projects in the harsh Antarctic environment, these successes are a testament to both scientific and engineering ingenuity and the logistical support needed to mount such ambitious and scientifically promising programs," said Scott Borg, who heads Antarctic Sciences in NSF's Office of Polar Programs.

Provided by Pennsylvania State University