Newly discovered salty subglacial lakes could help search for life in solar system

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A cold and windy spring night on the vast landscape of Devon Ice Cap -- twosubglacial lakes are lurking 750 m below the surface. Credit: Anja Rutishauser

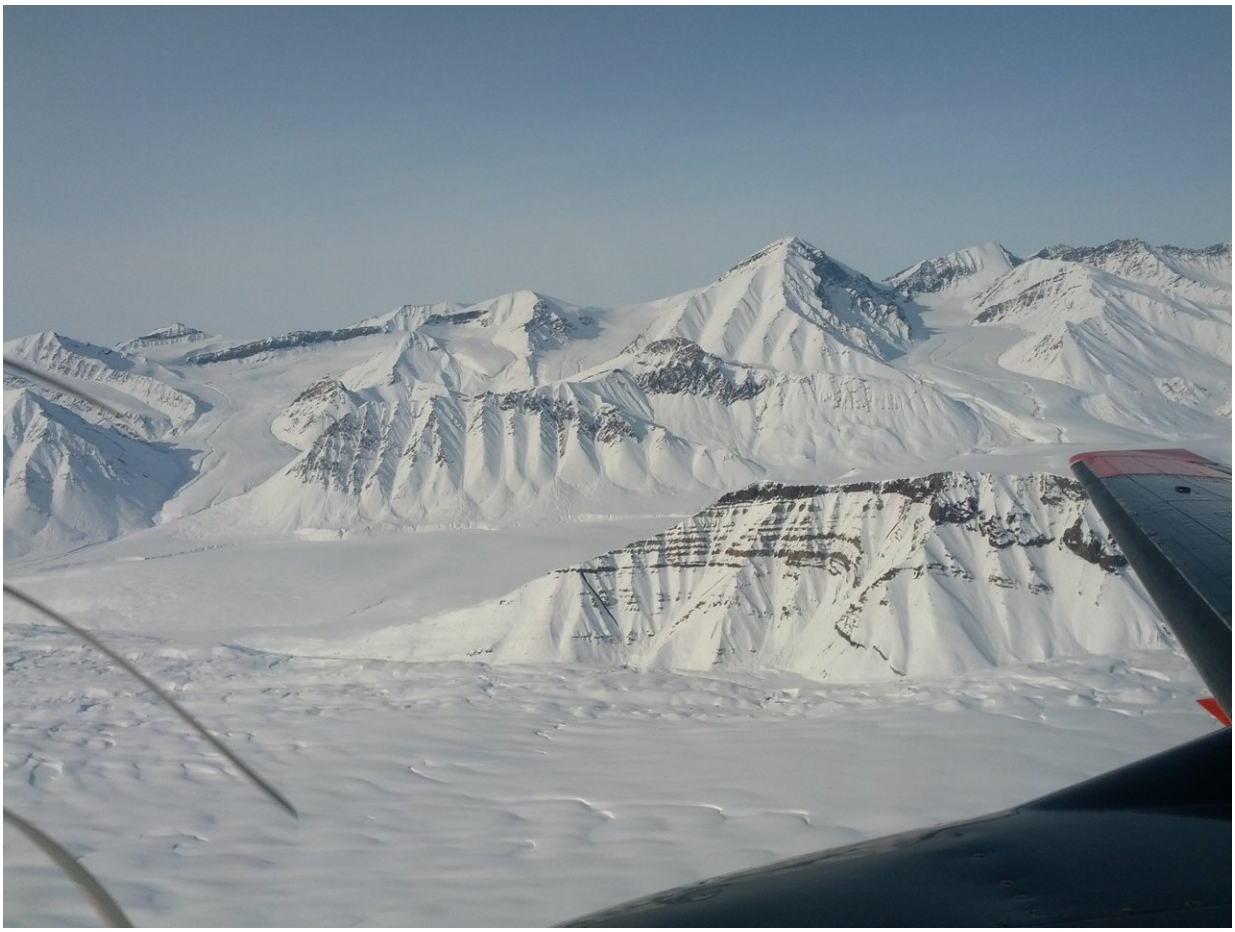
An analysis of radar data led scientists to an unexpected discovery of two lakes located beneath 550 to 750 metres of ice underneath the Devon Ice

Cap, one of the largest ice caps in the Canadian Arctic. They are thought to be the first isolated hypersaline subglacial lakes in the world.

"We weren't looking for subglacial lakes. The ice is frozen to the ground underneath that part of the Devon Ice Cap, so we didn't expect to find liquid water," said Anja Rutishauser, PhD student at the University of Alberta, who made the discovery while studying airborne radar data acquired by NASA and The University of Texas Institute for Geophysics (UTIG) to describe the bedrock conditions underneath the Devon Ice Cap. Ice penetrating radar sounding measurements are based on electromagnetic waves that are sent through the ice and reflected back at contrasts in the subsurface materials, essentially allowing scientists to see through the ice.

"We saw these radar signatures telling us there's water, but we thought it was impossible that there could be liquid water underneath this ice, where it is below -10C."

While there are more than 400 known subglacial lakes in the world, concentrated primarily in Antarctica with a few in Greenland, these are the first found in the Canadian Arctic. And unlike all the others—which are believed to contain freshwater—these two appear to consist of hypersaline water. Rutishauser explained that the source of the salinity comes from salt-bearing geologic outcrops underneath the ice.



In transit view during an aerogeophysical survey flight over Canadian Arcticice caps. Credit: Gregory Ng

Rutishauser collaborated with her PhD supervisor, UAlberta glaciologist Martin Sharp and University of Texas geophysicist Don Blankenship as well as other scientists from University of Texas at Austin, Montana State University, Stanford University, and the Scott Polar Research Institute to test her hypothesis. The bodies of water—roughly eight and five kilometres squared, respectively—exist at temperatures below freezing and are not connected to any marine water sources or surface meltwater inputs, but rather are hypersaline, containing water four to five times saltier than seawater, which allows the water to remain liquid

at these cold temperatures.

These newly discovered lakes are a potential habitat for microbial life and may assist scientists in the search for life beyond earth. Though all subglacial lakes are good analogues for life beyond Earth, the hypersaline nature of the Devon lakes makes them particularly tantalizing analogues for ice-covered moons in our solar system.

"We think they can serve as a good analogue for Europa, one of Jupiter's icy moons, which has similar conditions of salty liquid water underneath—and maybe within—an ice shell," said Rutishauser.

Pilots' view from the cockpit of a Kenn Borek Air Ltd. DC-3 aircraft duringan aerogeophysical survey flight over Canadian Arctic ice caps. Credit: Gregory Ng

"If there is microbial life in these lakes, it has likely been under the ice for at least 120,000 years, so it likely evolved in isolation. If we can collect a sample of the water, we may determine whether microbial life exists, how it evolved, and how it continues to live in this cold environment with no connection to the atmosphere."

Rutishauser believes that similar salty rock outcrops occur underneath other Canadian Arctic ice caps. "Although the Devon hypersaline subglacial lakes are very unique discoveries, we may find networks of brine-rich subglacial water systems elsewhere in the Canadian Arctic."

Rutishauser and her colleagues are now partnering with The W. Garfield Weston Foundation to undertake a more detailed airborne geophysical survey over the Devon Ice Cap this spring to derive more information about the lakes and their geological and hydrological contexts. For three generations, The W. Garfield Weston Foundation has pursued its mission to enhance and enrich the lives of Canadians. With a focus on medical research, the environment, and education, the Foundation aims to catalyze inquiry and innovation to bring about long-term change. As the Foundation marks its 60th anniversary, it continues to collaborate with a broad range of Canadian charities to further world-class research, explore new ideas, and create tangible benefits for the communities in which it works.

Following completion of her PhD with Sharp at the University of Alberta this summer, Rutishauser will start a postdoctoral fellowship in the fall at the University of Texas at Austin.

"Discovery of a hypersaline subglacial lake complex beneath Devon Ice Cap, Canadian Arctic" was published in the April 11 edition of *Science Advances*.

More information: A. Rutishauser el al., "Discovery of a hypersaline subglacial lake complex beneath Devon Ice Cap, Canadian Arctic," *Science Advances* (2018). DOI: 10.1126/sciadv.aar4353 , advances.sciencemag.org/content/4/4/eaar4353

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