

ADVANCING SUBGLACIAL SCIENCE: A BRIEF HISTORY OF HOT WATER DRILLING AT BRITISH ANTARCTIC SURVEY

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For nearly 50 years, hot water drilling has enabled direct access to and sampling of Antarctica's subglacial environments, providing critical insights into basal and ocean processes, ice sheet dynamics, and sub-ice ecosystems. British Antarctic Survey (BAS) was among the early adopters of this technique to support oceanographic and glaciological research and has maintained a continuous drilling program since the late 1970s. Over time, BAS has developed and refined hot water drilling systems and techniques, which use high-pressure hot water to melt boreholes through thick ice, allowing direct access to previously unobserved subglacial environments.

Early drilling operations began on warm 100-200 m thick ice on the George VI Ice Shelf, before progressing to colder, thicker ice on the Filcher-Ronne Ice Shelf, with access holes up to 941 m deep. In 2019, this evolution in depth capability culminated in multiple subglacial access holes on Rutford Ice Stream as part of the BEAMISH project. At 2,154 m, these are the deepest hot water drilled subglacial access boreholes to date and enabled the direct sampling of subglacial water and sediments, offering new insights into basal hydrology, ice stream behavior, and microbial life in extreme conditions.

A further major development was the 2012 Lake Ellsworth project. Although the lake was not reached, the project established a new benchmark for clean access drilling and sampling. It introduced rigorous environmental protocols, including multi-stage filtration, UV sterilization, and clean sampling systems that have since become the standard for subglacial exploration.

Challenges remain in developing lighter-weight, more efficient, and agile hot water drills. Also, achieving clean subglacial access into Antarctica's deep continental interior subglacial lakes remains an ongoing challenge for the global ice drilling community.

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