

UNIQUE IDP SUB-ICE DRILLING YIELDS SUCCESS FOR SCIENCE IN GREENLAND

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The U.S. National Science Foundation (NSF) Ice Drilling Program (IDP) provides specialized ice and sub-ice drilling technology and operational support to enable NSF-funded scientific discoveries about earth's past climate and the environment. As part of its multifaceted inventory of drills, IDP maintains the ice adapted Winkie and Agile Sub-Ice Geological (ASIG) drills to enable access to the basal zone of ice sheets of varying ice thickness. The Winkie Drill is optimized for light logistics with a depth capability of 0 - 100 m while the ASIG Drill is a larger system and extends the depth capability to 700 m. These drills have both successfully collected basal material from under shallow ice in Antarctica. This poster describes their first use on the Greenland Ice Sheet, where IDP drilled sediment and rock cores for the 2023 GreenDrill Prudhoe Dome project to collect basal material at a shallow and deep site.

During the Winkie drilling campaign, 96 m of blue ice was rapidly drilled using a new full face ice bit allowing for efficient access to the basal zone while reducing the logistics footprint of the drilling system. Battling issues with chip transport and poor weather, IDP used the Winkie Drill to collect 2 m of frozen sediment from below 96 m of ice over 17 days of drilling. During the 2024 GreenDrill season, IDP deployed a new coring system with larger waterways enabling efficient penetration through frozen sediment and clay.

At the deeper site, IDP used the ASIG Drill to drill through 509.4 m of ice to the bed and recover 7.5 m of core consisting of 3 m of sediment and 4.5 m of gneiss bedrock. Experiencing a hydro fracture event mid-season, the borehole was saved by trying a novel technique of resetting the casing string at a deeper depth and switching to normal circulation drilling. It was learned reverse circulation is not needed for efficient access to the basal zone, simplifying drill operation for future seasons.

During the 2023 GreenDrill season, IDP successfully deployed its Winkie and ASIG Drills at Prudhoe Dome to successfully recover a total of 9.4 m of basal material. Both drills more than doubled their previous depth records, and the lessons learned during operation will be invaluable for future drill technology development. Moving forward, IDP's successful sub-ice bedrock drilling breakthrough at Prudhoe Dome will open possibilities for further exploration of the basal zone.

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