

EGRIP Drilling 2016-2024

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At EGRIP an ice core was collected to 2663.63 m below the surface of the Northeast Greenland Ice Stream (NEGIS) using the latest modifications of the drill based on the Danish Hans Tausen (HT) concept (Johnsen et al., 2007). The end of the drilling at EGRIP was highlighted by penetration into the subglacial environment upon which wet sedimentary material was collected using a custom adaptation of rock cutting tools to the HT ice drill.

The execution of the EGRIP drilling presented many challenges and development opportunities for ice drilling with HT-technology and associated procedures. The EGRIP project was born out the foundations established from the drilling at NEEM (Popp et al., 2014) and the progressive evolution of technology and project organization that has a direct line stretching back more than four decades through deep drillings at NGRIP and pre-HT projects at Summit (GRIP), and DYE3, among others. From its inception in 1995, the HT design concept has been responsible for numerous deep ice core drilling projects, both in its Danish form and other internationally recognized versions of the same. Like previous projects, EGRIP provided an opportunity for educating drilling teams, testing new drilling hardware and procedures, and for testing new core and liquid handling systems to eventually be used for other programs.

Going into the project, challenges specific to drilling a deep ice core at EGRIP included uncertainty about conditions near the bedrock in a fast moving ice stream. Potential complications to drilling included the effects of basal sliding, the presence of liquid water, and in particular, the potential for borehole deformation due to ice flow velocity changes with depth. If present, deformation could inhibit drilling from one summer drilling season to the next, or potentially from one drill run to the next if severe enough.

Additionally, the advancement of continuous melting systems for the analysis of isotopic, gas, and impurity content of the ice core, required that a particular premium be placed on core quality at EGRIP, notably in the brittle zone, where at EGRIP there is the potential for annual layer counting in a zone underrepresented in the previous ensemble of Greenland ice core layer-counted chronologies.

Another challenge was the upgrade of aging motors and motor control units, surface and downhole electronic systems, and protocols for stable downhole communication, all of which ended up spanning the first several years of the project before stabilizing. One result of these upgrade efforts, however, included the ability to correct and control borehole inclination, which in turn fed into a new approach and eventual testing of a system for deviating from the parent borehole for replicate core drilling.

The EGRIP project was paused for two full drilling seasons due to the COVID pandemic response. The camp was left abandoned out of necessity from the conclusion of the 2019 season before reopening in 2022 with approximately 500 m remaining to be drilled. This pause seriously tested the lifespan of the subsurface tunnel systems developed for hosting the drilling infrastructure.

This talk will address these and other notable features of the EGRIP drilling. With the EGRIP camp now closed and all remaining equipment transferred to the old GRIP site at the summit of the ice sheet, a historical epoch in deep ice core drilling in Greenland has come full circle.

References

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