

Design and Development of Rapid Ice Sampling Devices

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Hot water drilling provides rapid access to depth in ice. Sampling with annular hot water drill lances is possible but gives samples of variable quality (Engelhardt et al., 2000; Liu et al., 2019, 2021). Here we take different approach, bailing water from the hole to allow ice sampling from an air-filled hole. Two prototype methods of ice sampling are proposed for use in dry, hot water-drilled boreholes: (1) A bottom hole core sampler, and (2) A sidewall core sampler. A challenge here is that the hot water drilling creates boreholes with variable diameter, in some cases with the diameter increasing up to double the diameter of the lance. The proposed bottom hole ice core sampler has a similar design to conventional electromechanical ice core drills; however, a key difference is the self-adjusting anti-torque system that mechanically adapts to the variation in hot water drilled borehole diameters. The novel design for the adjustable anti-torque system must provide a consistent torque reaction and, hence, remain in contact with the borehole wall as the diameter ranges from 125mm to 250mm while allowing the drill to move downwards as it cuts a sample. The proposed sidewall ice core sampler has expanding plates to adapt to diameter variation, and a core barrel that extends into the sidewall at a 60-degree angle. The prototypes for the bottom hole core sampler and the sidewall core sampler were successfully field tested on the McMurdo Ice Shelf, Antarctica.

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