

Brief Communication: The Danish Replicate Drilling System – Results from the First Field Test

Authors: Westhoff and others

General Comments

The concept and method presented in this paper for creating a notch in the wall of an ice borehole are novel and unique and worth publication. Overall, the content was well written and supported by the figures.

Was there a reason the inclination plots were not included as evidence of success in this paper? It is an important and critical feedback that can be used to determine the depth of both the broached groove and milled notch. Cable tension alone only doesn't give a good indication of how successful the milling operation was or if a large enough notch has been created to move on to the next step. Was a borehole camera deployed to get video or pictures of the groove or milled notch/step? If so, the images would be very interesting to include in this paper.

I recommend adding a section before the conclusion describing the next steps, modifications, and plans for further testing to demonstrate a full deviation can be completed and replicate cores recovered using this method.

Specific Comments

Lines 11-14: The sentence beginning with "By determining the borehole orientation..." does not make much sense as written and could use rewording for better clarity. I feel the following sentence misguides the reader into thinking that the purpose of the ledge is just for setting the weight of the drill on where I think the significance of the milling is to create a new guiding path for the core drill to exit the parent borehole. The two sentences could be replaced with something like "A groove is first cut on the uphill side of the borehole wall using a broaching process. This groove is then used to guide a milling tool to produce a circular notch and ledge in the downhill side of the borehole. Gravity would now guide the ice core drill into this newly formed notch diverging from the parent borehole, gradually producing full diameter replicate ice cores."

Section 1: I suggest adding a few sentences at the beginning of this section describing the benefits and importance of replicate coring and why it is important to continue to develop this technology.

Figure 2: Panels C & D show the new/duplicate hole inclined beyond vertical. This may give some readers the wrong impression and I suggest editing the schematic, so the new/duplicate borehole isn't shown inclined beyond vertical. I think it should be mentioned somewhere in the paper that the parent borehole must have a certain amount of inclination and the new/duplicate borehole must have an inclination between 0 and less than that of the parent borehole for this technique to work as presented. I also recommend labeling the key parts (broaching cutter, groove, spring, and milling head) in the pictures.

Line 80: Doesn't the parent borehole need to have inclination greater than 0 for this to work?

Figure 4: Labeling or highlighting in a bright color the key parts (broaching cutter, milling head, spring, and linear slide and bolt for limiting the travel) in the pictures that are described in the figure text would be helpful.

Lines 133 to 135: I suggest the rewording for better readability. “The drill is then pulled up 20 m to complete the first 2 mm deep cut. After lowering the drill back to the starting depth, the motor is rotated another 90 degrees, extending the broaching tool the full 5 mm into the side of the borehole. The drill is once again raised 20 m to complete the second cut, leaving a 5 mm deep and 30 mm wide groove.”

Line 141: Change this first instance of “AT” to “Anti-Torque (AT)”.