

DESIGN AND EXPERIMENTAL STUDY OF A PENDULUM-TYPE RECOVERABLE THERMAL MELT PROBE FOR VERTICAL ICE DRILLING IN POLAR REGIONS

Monday 15 September 2025 15:35 (5 minutes)

Thermal melt probe, which utilizes electric heating power to melt ice, is a clean and lightweight tool for ice drilling in polar regions. However, uneven heating power and drilling load on the thermal head often lead to deviations of the melting trajectory, making it difficult to maintain vertical drilling and reach the target depth. To address this issue, this study proposed a pendulum-type recoverable thermal melt probe (PRTMP) that integrates three independently controllable heating components: a lower thermal head, a central heating ring, and an upper thermal head. The lower thermal head and central heating ring work in coordination to generate a “pendulum effect,” which ensures vertical drilling and enables rapid inclination-correction. The upper drill head primarily facilitates return of the PRTMP. Laboratory experiments were conducted to investigate how the key design parameters, such as power distribution, diameter ratio, length-to-diameter ratio, and center of gravity, affect the change rate of borehole inclination. Based on the experimental results, optimal design parameters for achieving the best inclination-correction performance were identified. The system underwent preliminary field testing on Laohugou glacier No.12, Qilian Mountain. Field test results showed good performance of the PRTMP. The borehole inclination remained within 3° during 2.5 hours of continuous drilling. The inclination-correction capability of the PRTMP was significant, which can reducing the borehole inclination angle from 10.5° to 1.5° within one hour. In general, the vertical stability and the inclination-correction capability of the PRTMP proved to be an effective.

Primary author: LI, Xiaobing

Co-authors: LI, Yazhou (China University of Geosciences (Beijing)); LI, Bing (China University of Geosciences, Beijing, China)

Presenter: LI, Xiaobing

Session Classification: Poster sessions oral introduction

Track Classification: Probes