PICO

TECHNICAL NOTE

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Directional Drilling

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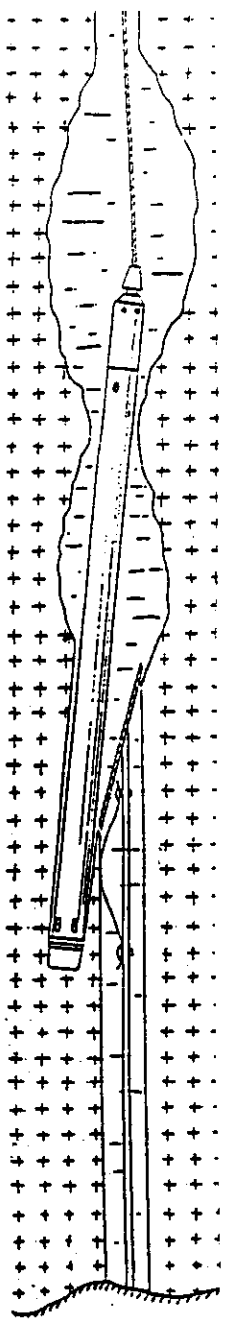

Introduction

In recent years an increasing number of research projects involving various scientific disciplines are involved in the study of ice cores, especially high quality deep cores from glaciers. Large volumes of ice extracted from depths of 500 m or more are desired. This problem can be solved in part by increasing the core diameter. However, another way to solve the problem is to obtain the necessary amount of ice from any depth after the borehole is drilled.

A primary problem of glacier physics is the study of ice properties under natural conditions (temperature, pressure, shear stress). These investigations can be accomplished through the simultaneous use of several parallel (inclined) boreholes which may be used for mounting sensors and transducers at specific locations.

Directional Drilling (DD) technology (Figure 1) can be used to obtain additional ice cores from any depth and to create adjacent boreholes for geophysical investigations of glacier ice in natural conditions.

In Industrial Drilling, special tools are used for diverting the drill to a defined direction. The extremely high cost and the complexity of the industrial technology make this type of drilling unacceptable for the study of glaciers.

Positive results have been obtained by using simple whipstocks for deflecting thermal drills in deep boreholes in Antarctica (Vostok Station). An electric hot-point drill at a depth of 570 m was deflected up to 32° by a whipstock on a temperate glacier. When the borehole reached the bottom at 587 m, the inclination was about 28°. Using the whipstock and an electric thermal drill combination, an additional 2.5-m ice core was obtained from the bottom portion (567 m) of Austfonna Ice Cape (Svalbard) (Figure 2). At present, the deflection of mechanical drills in glacier bore holes seems to be complex.

Conclusions

Using an antifreeze electric thermal drill, a whipstock, and mounting equipment will make it possible to (Figure 2):

- obtain additional ice cores from previously drilled boreholes from any depth;
- create several parallel or inclined boreholes for simultaneously mounting sensors and transducers; and
- obtain "fresh" ice cores from "old" boreholes: Camp Century (1966); Byrd Station (1968); Dye 3 (1981); GISP; GRIP.

Technical Notes are occasional reports on new developments and items of interest to the glaciological community. This is a publication of the Polar Ice Coring Office at the University of Alaska Fairbanks operated under contract to the National Science Foundation, Division of Polar Programs. Inquiries should be addressed to Director, PICO, University of Alaska Fairbanks, Fairbanks, Alaska 99775-1710. Phone: (907) 474-5585; FAX: (907) 474-5582.

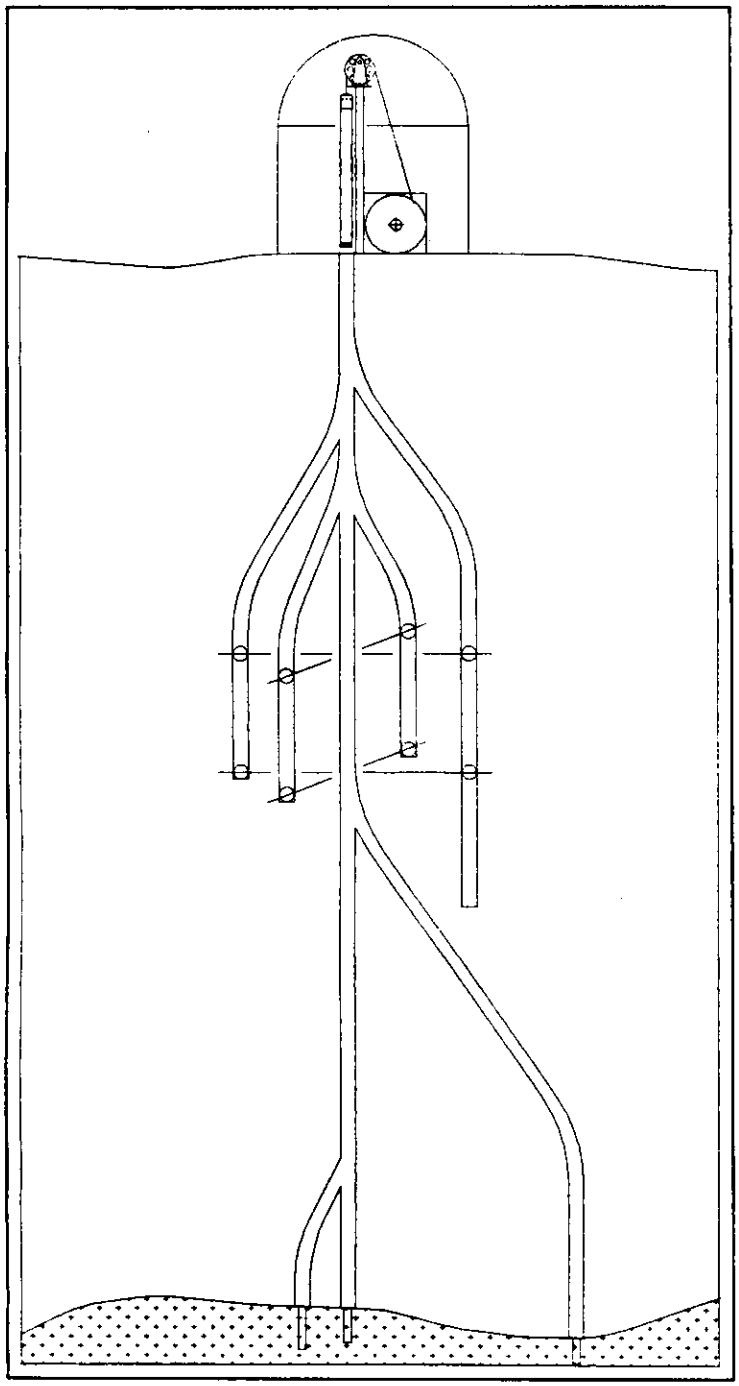

Figure 1. Schematic of branch holes created by directional drilling.

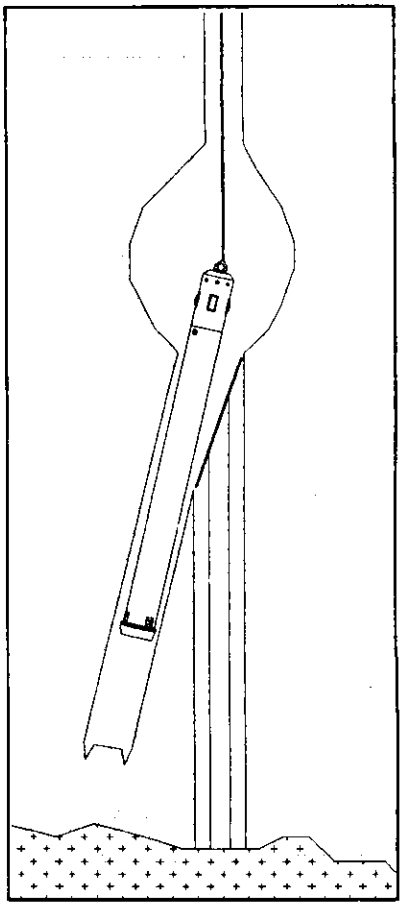

Figure 2. Schematic of taking an additional ice core from the bottom portion of Austfonna (Svalbard) ice cape.