NEW DIRECTIONS IN DRILLING AND RELATED ACTIVITIES

by

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ABSTRACT

This paper will deal with ways of improving drill performance using new material technologies and project improvement through use of lightweight shelters and improved core processing.

Composites play major role in continuing improvements by allowing increased design freedom. Areas of particular interest are anti-torque springs, drill barrels, and hand auger extensions.

New, stiffer cutting heads with tungsten carbide or synthetic diamonds significantly reduce cutter wear and are cheaper to produce than standard tool steel cutters. Standard rock drilling technology as applied to increasing sample size through interesting areas will be discussed.

The use of high pressure fluid to cut cores can significantly reduce contamination and provides a finished surface for analysis. Cutting swath is limited to less than 0.5 mm.

INTRODUCTION

When one mentions new technologies applied to drilling it often means applying proven technologies in new ways to answer new questions that arise. The new analytical techniques for ice chemistry require core that is tree of contamination and of better quality than previous samples. In addition the need for more and better samples of subice material has become apparent.

The question is how do we go about addressing these needs and what mechanisms or processes are available to allow the design freedom necessary to get access to the material.

It is essential to understand the process that occurs at the drill bit/ice interface. Cutter and core breaking geometry are at this point known for ice . We also know that round, straight tubing for the barrels and cutting heads that remain true are critical components in maintaining any hope of collecting good quality core beyond 150 m.

We are currently working with NOR Industries of Pawhuska, Oklahoma developing heads and cutters made of sintered material.

Heads can be made of sintered tungsten which remains round and will not easily be damaged by drilling or transportation. A typical 10 cm cutting head weighs nearly 10 kg which is desireable since keeping the weight low on the drill helps keep the hole straight.

Cutters and penetration shoes can be made of sintered tungsten-carbide which should drill many holes without sharpening. A complete ring of cutters and penetration shoes can be made for under $300 and because of the manufacturing process should be nearly perfect.

When entering the subice material this ring can be replaced by cutters more suitable for rock drilling provided the drill is heavy and has enough power to grind up rock. The mining industry and bit manufacturers such as Eastman Christiansen have the most advanced technology rather than the oil drilling industry.

Kaiser Rollmet of California has come up with a process for making tubing that is round, straight, and concentric. Their process involves roll forming the tube rather than drawing it which assures all of the above. While the cost of this tubing approaches $1,000/m, it comes inspected and nearly perfect. An added benefit is that the tubing is custom made. Hence it can be ordered to any size and thickness designed, increasing drill design flexibility considerably. Virtually any formable material can be used.

Experience has shown that we increased the core quality considerably below 150 m when we began using this tubing. The added benefit of being able to use all material supplied without rework, knowing that each of our drills is identical has strong merit which I believe overrides the cost factor.

Another consideration is the use of composite barrels which again because of the process are assured to be round and straight. In this case weight savings is not a consideration.

Flites can be wound onto the barrel as an integral part of the assembly and can be put on the inside of the outer barrel allowing the inner barrel to remain stationary.

In addition, a taper can be formed on the inner barrel allowing easier extraction of the core. Current wisdom suggest a taper of 0.25 mm/m.

Chemical inertness, low coefficient of friction and smooth finish add to the desirable qualities of this process.

These barrels can be made by ADDAX of Lincoln, Nebraska, a manufacturer of torsion shafts.

This past summer a set of extensions for the PICO hand auger made of graphite and Spectra was tested in Greenland. Their weight is 360 grams/m compared to 1,100 grams/m for the glass epoxy extensions currently used. The new extensions will survive torque and tension generally beyond human strenght. Their cost is approximately $100/m compared to $56/m for the standard water pipe extensions. They should allow expansion of the drill system to depths beyond 50 m which is especially important in high alpine areas of the planet.

When drilling deep cores greater than 1,000 m, there are depths where additional core material would be helpful. it is worthwhile noting that sidewall coring devices are available or a triangular piece can be cut out of the hole wall. Either of these samples can be placed in a pressurized container for time critical studies. Drilling additional holes off the main hole should also be considered since it too is standard a rock drilling technique.

Having retrieved core how is it best processed ?

A technique developed to cut composites and abrasive materials may be applicable. High pressure fluid (perhaps drilling fluid) forced through a small nozzle (less than 0.5 mm) under high pressure (3,000 bars) can be used. The cutting rate of ice should be high and the surface after cutting will be polished. Since a fluid is used there should be little contamination of the core and the absence of vibration should help keep the core in tact through the brittle ice zones. Experiments on cores will proceede in the spring of 1989.

Since the machine of the processing can be done in an enclosed area limiting the contamination as well as exposure of the processors to noxious drilling fluids. Samples for chemical analysis can also be taken with a measurable degree of cleanliness.

The drawbacks are cost of approximately $100,000 and high power requirements which approach 20 kw.

CONCLUSION

A lightweight dome was successfully tested in Greenland this past summer. Using 2033 aluminum alloy weight for the 6 meter dome is 60 kg. Struts and hubs are shown in Figures 2, 3, 4 and 5. In addition we have been using Moss Optimum series tents with good results. Both shelters provide a drift free zone around them.

The conclusions of this paper are more appropriately presented at the next symposium.

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