PRELIMINARY RESULTS OF DEEP DRILLING AT VOSTOK STATION, ANTARCTICA 1981-82

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ABSTRACT

A description is given of the deep thermal core drill being used at Vostok Station, East Antarctica. A report on the drilling progress is also given.

INTRODUCTION

In 1980, at Vostok Station, East Antarctica, drilling of a new, deep borehole was begun. Special low temperature liquid was developed and used to fill the bore hole to maintain its wall stability during drilling and subsequent logging operations.

The main objective of the first stage of deep drilling at Vostok Station in 1980-81, was the full scale trials of new equipment and procedures for thermal coring in liquid filled holes in very cold ice. A new thermal, cable suspended drill, designed at the Leningrad Mining Institute, was tested. It was built as a mobile rig and transported to Vostok Station by sled-tractor train.

DESCRIPTION OF THE EQUIPMENT

The mobile drilling installation (PBU-2) is a heated drilling facility with a heated metal tower extending 7 m above the roof of the building. The rig is sled mounted. In the shelter, there is an electrically driven hoist (10 kW), an electrical control panel for the drills and winch, 2 diesel electric generators (16 kW each), a water heating unit as well as lighting and heating equipment.

There are three electro-mechanical cables.

The KEMMP-6 is 22 mm in diameter and weighs 1400 kg/km. There are three copper cored power cables (each core is 4 mm^2 in cross-sectional area) and three signal cores (each 0.75 mm^2 in cross-sectional area).

The KG-7 cable is 16.5 mm in diameter and weighs 890 kg/km. There are seven power conductors (each 2.5 mm^2 in cross-sectional area).

The KG-2 cable is 11.5 mm in diameter and weighs 400 kg/km. It has a central copper conductor 4 mm^2 in cross-sectional area.

Depending on the power rating of the separate units and the cable losses, the heater units are operated at 40-1000 V AC or DC, at 50-2500 Hz.

Drilling of the first 112 m was carried out using a TELGA-14M core drill (Korotkevich and Kudryashov, 1976) designed for coring 180 mm ϕ dry holes.

Drilling beyond this depth was carried out using the TBZS-152M core drill (Fig. 1). A hydrocarbon based liquid, the concentration of which was regulated according to the temperature, was used to fill the hole below the firn-ice transition. It provided the required hydrostatic pressure to inhibit hole closure.

The annular heater of the core drill operates at 3.0-3.5 kW, producing a drilling rate of from 2.0-2.5 m/h. An average run is 2 m. Mean core and

hole diameters are 110 mm and 154 mm respectively.

Although perfect balance of the ice pressure is unlikely, no obvious difficulties resulting from any hole closure at pressures of from 2 to 4 MPa were experienced. All the systems and units of the drill (the heater, the melt water sections core lifters and pressure gages) proved reliable and efficient.

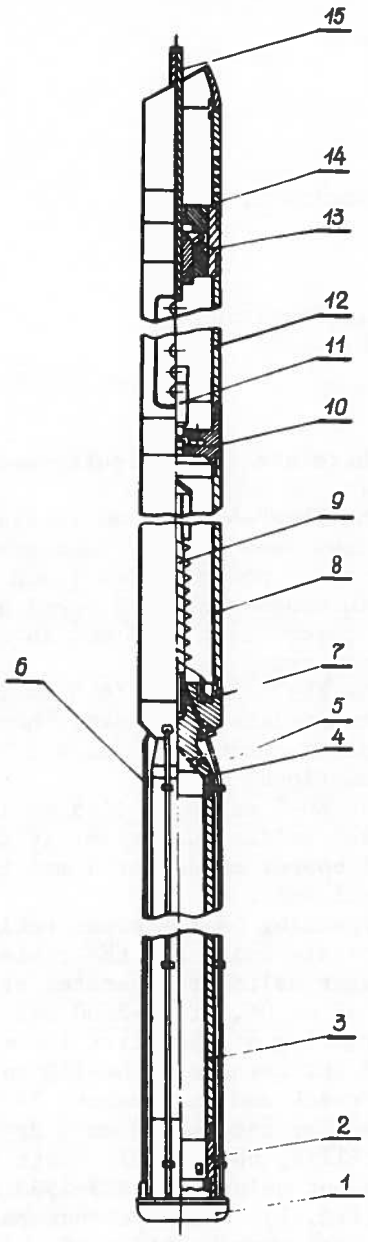

Figure 1. The TBZS-152M thermal core drill. (1) Heater ring (2) Core lifter (3) Core barrel (4) Drain adapter (5) Water pipes (6) Heater power cable (7) Water heater (8) Tank (9) Water pipe (10) Pump adapter (11) Pump (12) Electrical section (13) Cable termination (14) End cap (15) Electro-mechanical cable.

During drilling, a number of new techniques were developed and tested. These included an automatic down winching system, a system thyristor control of the heater power and new cable construction and termination.

Early in 1981, after a depth of 1500 m was reached, the drilling continued using the TBS-112 HF core drill with a high frequency power transformation which significantly reduces cable power losses and allows more power to be available for melting ice (up to 5 kW). The hole diameter was reduced to 112 mm. The drilling rate of the new drill increased to 3.5 to 4.0 m/h and early in 1982, the Vostok N/3G hole was 2000 m deep.

This hole was logged for temperature, bore hole geometry and some physical and mechanical properties adjacent to the hole wall.

Core recovery was 99.9 % and quality was high.

REFERENCE

Korotkevich, Ye.S. and B.B. Kudryashov (1976) Ice sheet drilling by Soviet Antarctic Expeditions. In *Ice Core Drilling*. Editor: J. Splettestoesser. Univ. of Nebraska Press. p. 63-70.