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HOT-WATER DRILLING ON CRARY ICE RISE, ANTARCTICA

(Abstract)

by

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A new hot-water drill was used successfully to drill two holes to the bed of Crary Ice Rise. Hole depths were 370 and 480 m. Average drilling rates of 0.4–0.5 m/min were employed to ensure a large hole diameter. Instrumentation on the drill stem provided data on inclination (two axis), hole diameter, water depth, and water temperature near the nozzle opening and at two other points along the drill stem. These data were available for review during the drilling, as well as being recorded on diskette by a personal computer. Water in the system was recirculated by means of a pump, suspended 40 m down the hole, which kept a 500 gallon tank on the surface filled. Water was heated to 90 °C by a set of six standard car-wash heaters.

In the first hole (370 m), the bed was sensed by the simultaneous occurrence of three events: a decrease in tension in the drilling hose, an increase in the water pressure of the drilling system (normally 180 psi), and an indicated increase in tilt of the inclinometers on the drill stem.

In the second hole (480 m), a similar coincidence of events occurred but the drill remained at this level for approximately 1 h before being raised to the surface. When the drill was returned to the surface, the drill stem was coated with a thick mud, and a rock and a clast were lodged in the caliper arms of the drill.

The rock is strongly faceted, igneous in composition, and appears to be a member of a lodgement till. Striations cannot be seen; scanning electron microscopy is planned to search for microscopic striations. The loose sedimentary material contains a large amount of gravel. This material is rich in diatoms. R. Scherer (personal communication) has identified the youngest diatoms in the sediment to be of Upper Miocene age. The clast seems to be composed of sedimentaty material and may be more representative of how this material exists *in situ* beneath Crary Ice Rise.

A PHENOMENOLOGICAL CONSTITUTIVE EQUATION

(Abstract)

by

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When the Sinha equation is constrained to describe laboratory ice in uniaxial compression, it degenerates to the Andrade form, a modification of which is shown to offer a good fit to data extending into the tertiary creep stage.

RELATION BETWEEN WATER INPUT, BASAL WATER PRESSURE, AND SLIDING OF COLUMBIA GLACIER, ALASKA, U.S.A.

(Abstract)

by

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The University of Colorado and Caltech, together with personnel from the U.S. Geological Survey and the University of Washington, drilled through Columbia Glacier at two locations (ice thickness 975 and 560 m) 9 km apart in the summer of 1987. Fluctuations in basal water pressure, water input as rain or ice melt, and surface-ice velocities were measured at short time intervals continuously during July and August. Surface velocities are essentially equal to sliding velocities in these areas of rapid flow (3–10 m/d) and high basal water pressure (nearly equal to flotation).

Experiments at the bed (planned and unplanned) suggest a thin layer of deforming fluidized material at the base, overlying rough bedrock. The sliding rate showed daily peaks related to peaks in ice melt, and longer-period peaks due to rainstorms or windstorms. Basal water pressure showed daily peaks related to water input, but did not necessarily rise at the times of storms and, in some cases, showed step-like drops at the end of these storms. No evidence was seen of "mini-surge" events or traveling waves of either sliding or water pressure. The Columbia Glacier results suggest that sliding is not a function of just driving stress and effective pressure; the amount (thickness and/or areal extent) of water, or possibly the rate of change of water input, will have to be considered.

OBSERVED VELOCITY FLUCTUATIONS ON A MAJOR ANTARCTIC ICE STREAM

(Abstract)

by

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Ice in the mouth of Ice Stream B, a large glacier in West Antarctica, has slowed by about 20% over a 10 year period. Recent measurements of velocity were made between 1983 and 1988 during the Siple Coast project (SCP) on a 100 km section of ice extending from the ice shelf just up-stream of Crary Ice Rise on to the ice plain of Ice Stream B (see Fig. 1). They are compared to three velocities measured during the Ross Ice Shelf Geophysical and Glaciological Survey (1973–75). Velocities in both surveys were measured using doppler satellite-tracking methods. The data are given in Table I. Measured strain-rates are used to define a linear strain field which allowed the recent velocities to be extrapolated to the position of the RIGGS measurements. The comparison is given in Table II. The deceleration is above measurement uncertainties, which were estimated at about ±50 m a^{-1} for the 90% confidence limit. This may be a response to regional thickening down-stream (MacAyeal and others, 1987) in the region around Crary Ice Rise. Other possible causes include a response to the stagnation of nearby Ice Stream C, changes in basal conditions, or external forcing.

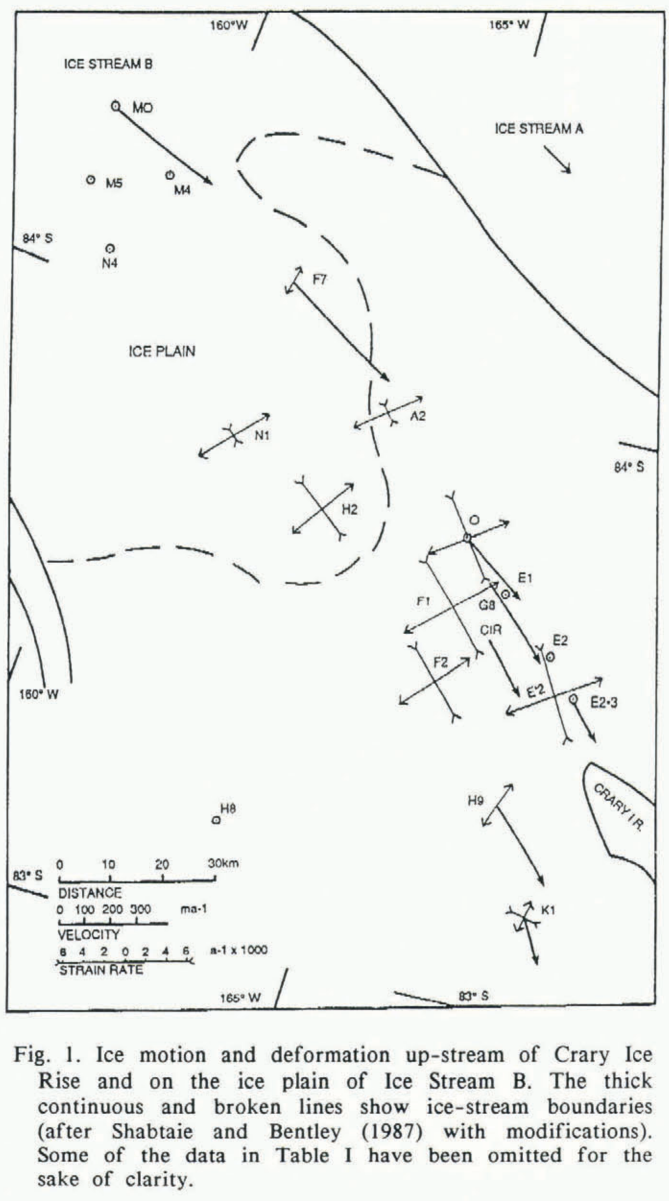

Fig. 1. Ice motion and deformation up-stream of Crary Ice Rise and on the ice plain of Ice Stream B. The thick continuous and broken lines show ice-stream boundaries (after Shabtaie and Bentley (1987) with modifications). Some of the data in Table I have been omitted for the sake of clarity.

REFERENCES

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