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ABSTRACTS OF PAPERS ON RECENT WORK PRESENTED AT THE SYMPOSIUM

FABRIC IN ICE SHEETS: DEVELOPMENT AND PREDICTION

(Abstract)

by

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c-axis fabrics in ice sheets provide a record of deformational history and control the rate of current deformation. Fabrics are developed by grain rotation at low strain-rates and temperatures, and by recrystallization at higher strain-rates and temperatures. In ice sheets characterized by longitudinal extension and vertical compression, basal shear, parallel flow, and divergent flow cause *c*-axes to rotate toward the vertical axis; rotation is faster parallel to flow than transverse to flow in basal shear and parallel flow, but it is independent of azimuth in divergent flow. Convergent flow causes *c*-axes to rotate toward a vertical plane transverse to flow. Cumulative strain, ice hardness, and stress state can be estimated from measured fabric patterns. Alternatively, fabric patterns can be predicted from observed surface strain-rates. Such predictions are confirmed by fabrics determined seismically on Ice Stream B, Antarctica, as well as by comparison with directly measured fabrics from other sites.

A paper reporting much of this work has been published in *Science* (Alley, 1988).

REFERENCE

Alley, R.B. 1988. Fabrics in polar ice sheets: development and prediction. *Science*, **240**(4851), 493-495.

THE SEDIMENTARY SIGNATURE OF DEFORMING GLACIER BEDS IN THE ROSS EMBAYMENT, ANTARCTICA

(Abstract)

by

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Interpretation of seismic and glaciological data from the UpB camp on Ice Stream B, West Antarctica, suggests that the ice stream moves largely by deformation occurring within a meters thick, subglacial till layer resting unconformably on older sediments. The hypothesis that the bed of Ice Stream B has been deforming at least since the post-Wisconsinan sea-level rise implies that a "till delta" probably tens of meters thick and tens of kilometers long has been deposited at the grounding line; recent gephysical measurements (Shabtaie and Bentley, 1987; Blankenship and others, 1989) have provided evidence for the existence of this feature.

Significant sea-level fall would cause increased coupling between ice and till over the head of this delta, leading to erosion there, deposition at the grounding line, and conveyor-belt advance of the delta. The bathymetry of the Ross Sea suggests that this process would continue to the edge of the continental shelf for likely glacial maximum sea-level fall, leading to development of a low-profile, till-lubricated ice sheet. Subsequent sea-level rise would cause grounding-line retreat, leaving a meters thick, uniform till resting unconformably on older sediments. The modern Ross Sea is characterized by a regional angular unconformity, the Ross Sea unconformity, overlain by a meters thick, homogeneous diamicton that many investigators consider to be a till of Plio-Pleistocene age (e.g. Anderson and others, 1980), although both the age and depositional environment are debated. We hypothesize that the Ross Sea unconformity and overlying deposits record the extension of the UpB deforming till to the edge of the continental shelf during Wisconsinan (and earlier) sea-level low stands.

A paper reporting much of this work has been accepted for publication in *Marine Geology* (Alley and others, in press).

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SEASONAL CHANGES IN ICEBERG DISTRIBUTION OFF EAST ANTARCTICA

(Abstract)

by

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Observations of iceberg numbers and size distributions have been used by various authors to derive estimates of iceberg dissolution rate and of the Antarctic ice-sheet mass discharge (e.g. Budd and others, 1980; Orheim, 1980, 1985; Hamley and Budd, 1986; Wadhams, 1988). A comparison of these studies, however, shows large differences between the distributions, partly because they cover different regions and seasons, or because they use different size categories, but also because there are observational problems including the difficulty of correctly determining the numbers of smaller icebergs, either visually or by radar (Wadhams, 1988; Musil, in press), and the non-standardization of techniques and observers.

In this work we consider iceberg observations made along east–west transects between 85° and 105°E and between 61° and 63°S in 1986–87. Transects were made through this region at three different times of year; in late October and mid-November (MV *Icebird*) and in mid-January (MV *Nella Dan*). The first two voyages were made within the pack-ice edge in ice typically of 3–5/10 concentration, whereas the last was in open water. Nearly 1000 icebergs (each within 6 nautical miles of the ships) were routinely observed visually and classified, all by the same observers using standarized techniques.

The iceberg distributions in logarithmically sized categories are shown in Figure 1 for each voyage. While there is little change in distribution between October and November, there is a significant shift to more and smaller icebergs by January. (The distribution of icebergs less than 50 m wide should not be considered because of the difficulties of observing these accurately.) It is suggested that the change in distribution occurs after the icebergs are free of the winter pack ice; both warmer temperatures and swell in the open sea result in rapid break-up. Using a method similar to that of Budd and others (1980), the different distributions between October/November and January can be accounted for if 60% of the icebergs break during the 60 d period in open water. The median life of icebergs down to 200 m is as low as 0.15 year once they are in open sea.

The icebergs also show a shift during all seasons to smaller sizes as they move down-stream in the Antarctic Circumpolar Current as shown by Hamley and Budd (1986), and there is a considerable loss in the total observed mass due to wastage and melt (up to 50% between November and January) in the shift to smaller sizes.

Overall, the observations suggest that careful observation of iceberg-distribution statistics can provide information on dissolution rates and processes, provided that the season of observation is also considered, but the hope that the Antarctic mass balance can be estimated from iceberg distributions with any accuracy is probably optimistic. The episodic calving of giant icebergs from major ice shelves (e.g. the Filchner, Larsen, and Shackleton in 1986, and the Ross in 1987) can significantly affect both the spatial and temporal distribution of icebergs.

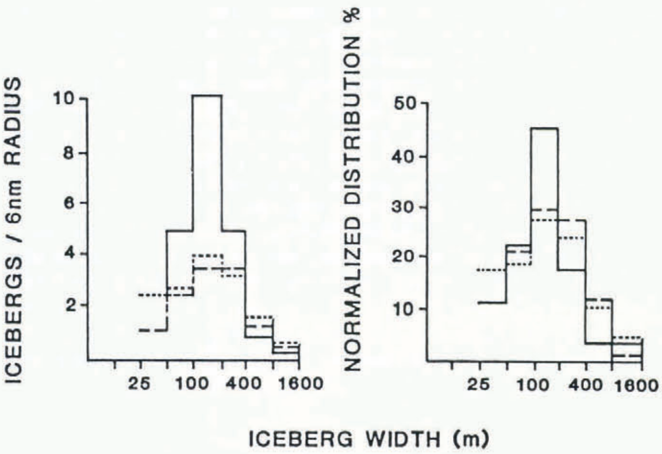

Fig. 1. Observed iceberg-size distributions in late October 1986 (dotted line), mid-November 1986 (dashed line), and mid-January 1987 (solid line).

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