DENSIFICATION OF POLAR ICE AFTER THE CLOSE-OFF (ABSTRACT)

Pierre PIMIENTA and Paul DUVAL

Laboratoire de Glaciologie et de Geophysique de l'Environnement, B.P. 96, 38402 St Martin d'Heres Cedex, France

Polar ice sheet flow is hindered by limited knowledge of the rheological law for polycrystalline ice. Theoretical considerations, laboratory experiments and inclinometer data support a value lower than 2 for the exponent of the flow law relating stress and strain rate in polar ice at low stresses (P. PIMIENTA and P. DUVAL: J. Phys. (Paris), **48**, 243, 1987).

Another way of identifying deformation processes of ice at low stresses is to analyze the densification of the upper layers in polar ice sheets. After the close-off the densification is determined by the creep of the thick spherical shell surrounding each bubble. The densification rates by power law creep and by diffusion can be calculated by using the models presented by E. ARTZ *et al.* (Metall. Trans., **14**, 211, 1983). The power law creep model was used with $n=3$ and $n=1$. A good fit to the experimental results given by A. J. GOW (J. Glaciol., **7**, 167, 1968) was obtained taking successively $n=3$ and $n=1$ (the effective pressure ΔP decreases when depth increases; at Byrd Station the transition takes place when $\Delta P=0.4$ MPa). On the other hand, the densification rates deduced from the diffusion model are about one order of magnitude lower than experimental values. The quasi-Newtonian behavior of polar ice deduced from laboratory tests and inclinometer data is therefore supported by this analysis.

The simulation of polar ice densification from the power law creep model leads us to some interesting results. The overall polar ice density profile is dependent on temperature and accumulation rate. The effective stresses around bubbles in regions as cold as Vostok Station are more important than shear stresses even at depths as deep as 500 m. Therefore they can have an important role in the polar ice sheet flow, as dislocation sources for example.

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ICE FLOW BEHAVIOR AT DYE 3, GREENLAND (ABSTRACT)

Hitoshi SHOJI[1] and Chester C. LANGWAY, Jr.[2]

[1]*Faculty of Science, Toyama University, 3190, Gofuku, Toyama 930*
[2]*Ice Core Laboratory, Department of Geology, State University of New York at Buffalo, 4240 Ridge Lea Road, Amherst, New York 14226, U.S.A.*

To understand the flow behavior of large polar ice masses, mechanical property studies have been conducted on deep ice core samples obtained at Dye 3, Greenland during the GISP field operations from 1979 to 1981. A strain rate enhancement factor profile obtained by making uniaxial compression tests shows (1) much higher enhancement factor values for Wisconsin age ice compared with Holocene ice and (2) characteristic changes in the enhancement factor value for the Wisconsin ice depth zone. These results were incorporated to calculate both horizontal and vertical flow velocity profiles of ice which are in good agreement with the results of borehole tilting measurements and computer models of flow dynamics. The finding of depth changes in enhancement factor value leads to a consideration of possible formation of boudinage structure. Further studies are required to fully understand the differential flow behavior of large ice sheets.

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