AN ANALYTICAL APPROACH TO DEFORMATION OF ANISOTROPIC ICE CRYSTAL AGGREGATES

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ABSTRACT

Deformation rates of single hexagonal crystals, deforming by glide on the basal plane, are described as a function of stress state and crystal orientation. These results are used to infer the deformation rate of crystal aggregates assuming that the stress distribution within the crystal aggregate is homogeneous. Analytical equations for the deformation rate of anisotropic ice aggregates are derived for vertically symmetric girdle fabric. This type of fabric is approximated by a uniform distribution of c-axis orientations between a cone angle and a smaller girdle angle relative to the symmetry axis. For simple shear stress acting on a single maximum fabric there is a slight de-enhancement for cone angles between 60° and 90°. In uniaxial compression a maximum enhancement of ~1.7 occurs at a cone angle of 57°. A pure shear stress state has similar features with the additional complication that it causes a non-zero transverse strain rate, except for perfect vertical alignment of crystals and isotropic fabric. In combined states of stress the contribution of each stress component to the strain rate depends on fabric. A single enhancement factor is not adequate to describe the effects of anisotropy for complex stress states.

Published in

Journal of Glaciology, Vol. **47**, No. 158, p. 507-516, 2001.

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