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STRAIN RATES AND CRYSTAL ORIENTATION FABRICS FROM THE LABORATORY DEFORMATION OF ICE FROM DOME SUMMIT SOUTH, LAW DOME, EAST ANTARCTICA

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An accurate quantitative description of the relationship between the stresses in ice masses and the resulting deformation strain rates is a critical ingredient in successfully modelling their flow. One of the deficiencies in current models of ice sheets and ice shelves arises from neglecting the anisotropic crystal structures that are known to develop and which strongly influence long-term flow rates. An improved understanding of crystal fabric effects is essential for more accurate prediction of the dynamics of ice flow.

Results are presented of long term deformation experiments conducted on polycrystalline anisotropic ice obtained from the Dome Summit South (DSS) borehole, drilled 4.7 km from the summit of Law Dome, East Antarctica. Deformation experimental parameters approximated in situ conditions. Samples with a range of crystal orientation fabrics were deformed in horizontal shear at octahedral shear stresses of 0.075, 0.1 and 0.15 MPa with deformation unconstrained in the vertical direction. Minimum octahedral shear strain rates were obtained for temperatures between –2 and –20˚C. Identical experiments were also conducted on laboratory made isotropic polycrystalline ice to enable the flow relation for anisotropic ice under horizontal shear to be determined with reference to the minimum isotropic strain rate.

The effects of stress, temperature and crystal orientation fabric on strain rate are also discussed with reference to strain rates determined from DSS borehole inclination measurements and modelled strain rates calculated using a flow law for anisotropic polycrystalline ice.