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STRAIN RATE ENHANCEMENT AT DYE 3, GREENLAND

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Abstract. Ice at depth in ice sheets can be softer in bed-parallel shear than Glen's flow law predicts. For example, at Dye 3, Greenland, enhancement-factors of 3-4 are needed in order to explain the rate of bore-hole tilting. Previous authors have identified crystal fabric as the dominant contributor, but the role of impurities and crystal size is still incompletely resolved. Here we use two formulations of anisotropic flow laws for ice (Azuma's and Sachs' models) to account for the effects of anisotropy and show that the measured anisotropy of the ice at Dye 3, Greenland, cannot explain all the detailed variations in the measured strain rates. The jump in enhancement across the Holocene-Wisconsin boundary is larger than expected from the measured fabrics alone. Dust and soluble ion concentration divided by crystal size correlates well with the residual enhancement, indicating that most of the "excess deformation" may be due to impurities or crystal size. While the major features of the deformation at Dye 3 are explained by anisotropy and temperature, results also suggest that further research into the role of impurities and crystal size is warranted.