DYNAMIC GRAIN BOUNDARY MIGRATION
AND FABRIC DEVELOPMENT:
OBSERVATIONS, EXPERIMENTS AND SIMULATIONS

by

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ABSTRACT

In-situ observations of a deforming aggregate of the hexagonal material octachloropropane have been analysed. Calculations of micro-strains and measurement of c-axis orientations have enabled the processes influencing fabric development to be distinguished, and the importance of dynamic grain boundary migration to be assessed. It was found that in this material, inter-grain strain contrasts could be significant, and that the effect of grain boundary migration was to modify the fabric in a measurable way. A simple model for the driving force for grain boundary migration based on dislocation density contrasts, as controlled by intra-grain strains and grain orientations, is proposed and tested and can account for the migration direction of most of the observed boundaries.

Several grain-scale microstructures are described that demonstrate the migration direction of once-mobile grain boundaries in a naturally deformed quartzite. I present an analysis of the sense of migration of the boundaries and the characteristics of the patterns of relative grain growth and shrinkage. Grain boundary migration can be correlated with the relative crystallographic orientations of neighbouring grains.

A new computer simulation of the development of grain shape and crystallographic preferred orientations is presented. This model combines homogeneous strains,

simplified versions of the lattice rotations predicted by Taylor-Bishop-Hill theory, mobile grain boundaries and the nucleation of new grains, and allows the progressive development of the fabrics to be followed. The model generates several commonly measured quartz c-axis fabrics, while at the same time predicting characteristic variations in average grain sizes and the intensity of grain shape fabrics that arise from differing recrystallization regimes and strain geometries.

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If you can look into the seeds of time, and say which grain will grow and which will not, speak then to me.

Shakespeare

(Macbeth I iii)