HIGH TEMPERATURE DEFORMATION OF OCTACHLOROPROPANE: A MICROSTRUCTURAL STUDY

by

Jin-Han Ree

A Dissertation

Submitted to the State University of New York at Albany

in Partial Fulfillment of

the Requirements for the Degree of

Doctor of Philosophy

College of Sciences and Mathematics

Department of Geological Sciences

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ABSTRACT

As an aid to understanding the high-temperature microstructures of rocks, the development of microstructures in the hexagonal organic material, octachloropropane, was studied with *in-situ* optical microscopy. It was found that the deformation behavior of grains in hard and soft orientations for slip is different during simple shearing, although they both grow. Strain heterogeneity is induced by partitioning of deformation into relatively increased components of rigid-body rotation and translation in hard grains and strains in soft grains.

A steady-state foliation, having a constant intensity and orientation was observed in simple shearing. The steady state is maintained by a balance between foliation-strengthening and -weakening processes. The major foliation-strengthening process is intragranular strain, and the major foliation-weakening process is dynamic recrystallization including migration of straight or slightly wavy grain boundaries, grain dissection and rotational recrystallization. Other minor weakening processes are grain amalgamation, relative rigidity of hard grains and grain boundary sliding. Foliation intensity is lower than the axial ratio of the bulk strain ellipse by a factor 0.2 - 0.4 at a total shear strain of 1.3 - 1.8, indicating that grain-shape foliations of this type cannot be used for strain calculation.

Subgrain boundaries which appear similar under optical microscopy originate in seven different ways. They are classical polygonization, kinking, misorientation reduction, grain coalescence, impingement of migrating subgrain boundaries, edgewise propagation, and static development of subgrain boundaries from optically strain-free grains. The preferred orientation of subgrain boundaries with respect to the grain-shape foliation is symmetric in pure-sheared samples and asymmetric in simple-sheared samples.

Grain boundary sliding can occur by discontinuities in the strain, rotation and/or translation components of deformation across the boundary in deforming samples. Grain boundary diffusion and intragranular plastic deformation are found to be effective in accommodating grain boundary sliding. Grain boundary openings can develop in association with grain boundary sliding, preferentially along grain boundaries at a low angle to the shortening direction. Once grain boundary openings occur, they continuously change their shape and are eventually closed by thrusting of sliding grains and grain overgrowth into the openings. An approximately equal volume of new openings grow in other places, however, maintaining a steady ratio of 0.5 - 3% of the sample volume without development of any large scale fracture. The opening and closing of grain boundaries usually involve neighbor switching of surrounding grains.

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