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
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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 weak 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.
ACKNOWLEDGEMENTS

This dissertation has benefited from the direct or indirect help of many people. Win Means proposed the topic of this dissertation, and many of the ideas of this study were materialized through discussions with him during our informal 'coin' meetings and 'man-to-man' meetings. I thank him for his continuous support and patience throughout my research at Albany. His financial support made my travels to GSA annual meetings and the Leeds Conference meeting possible, where I was able to present my papers, discuss many topics related to my research with other structural geologists, and open my eyes to current issues of structural geology. Also my two-month visit to the University of Utrecht was possible because of his beneficence. There I learned Utrecht's further development of synkinematic microscopy, computer programs and image analysis, and I conducted a series of creep tests on paradichlorobenzene. I would like to thank Brian Bayly, Jan Tullis, Bill Kidd, Mark Jessell, Janos Urai, Peter Hudleston, Rob Knipe, Jane Gilotti, Paul Bons and Chris Mawer for reading part or all of this work and for making critical comments which resulted in substantial improvements. I also thank Bruce Hobbs and Mike Etheridge for suggesting some helpful ideas for my research project when they visited Albany.

I thank Janos Urai and Cees Passchier for making my visit to Utrecht possible. During my stay there, discussions with Paul Bons and Coen ten Brink helped to improve my computer programs used in this study. I also thank Janos Urai and Chris Spier for suggesting some helpful ideas for my research project during the stay. Dean D. Wulff of the College of Sciences and Mathematics, SUNYA, also provided some financial support for my visit to Utrecht.

I benefited from discussions with faculty members of the department, John Delano, Steve DeLong, Greg Harper and George Putman, and fellow graduate students, Youngdo Park, Young-Joon Lee, Yun Pan and Rob Alexander through my student
seminars or at my request. Steve Tice, Rob Alexander and Terry Spell helped to improve my English and did not mind my pop-in visits to their office. I particularly thank Youngdo Park and Jaiyoung Rhi, who were always on hand whenever I had a problem with computer programing. Diana Paton kept administrative troubles away from me. Brian Taylor helped lessen technical problems with my experiments.

I thank the late Professor Bong-Soon Park, who was my Master's thesis advisor at Korea University. He ignited my interest in structural geology, and encouraged me to continue studying in the U.S.A. Chris Mawer and Jeff Grambling of the University of New Mexico (Chris is now in Australia), and James Roberston and Paul Bauer of the New Mexico Institute of Mining and Technology helped me to go to the 'right' place for my Ph.D. study when I first came to the U.S.A. I thank all of them.

My study at Albany would not have been possible without the support of my parents and parents-in-law. I particularly thank my mother for coming to Albany to take care of my baby, Hwisoo, while I was in Utrecht and my wife, Boknam, was at school. I also thank Yunmi Kim for taking care of Hwisoo without any problem while we both were at school. Finally I thank Boknam for her patience and love throughout my study. This work was funded by U.S. National Science Foundation grants EAR8506810 and EAR8803096 to Win Means.
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