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Preface

Frontiers and grand challenges in mineral physics of the deep mantle

Mineral physics has made indispensable contributions to multi-disciplinary research efforts with the goal of understanding the behavior of the Earth's deep mantle. The importance of understanding the physical and chemical properties of the deep-mantle materials under relevant pressure-temperature conditions is manifested by the many recent discoveries and critical observations made through high pressure-temperature experimental measurements and theoretical predictions. During the period of 2002-2007, there have been a few "Grand Challenge" projects supported by National Science Foundation in the area of mineral physics including the experimental studies of elasticity and plastic deformation. The growing interest in the mineral physics of the deep mantle was partially reflected by a large number of 74 presentations at the Fall 2006 Mineral Physics Session of the American Geophysical Union entitled, "Composition and Dynamics of Earth's Mantle: Current Frontiers and Grand Challenges in Elasticity, Phase Transitions, and Rheology Studies". Motivated by these strong interests from the deep-mantle community, we have edited this special issue which offers a collection of manuscripts in active research areas. A large fraction of contributions presented in this special volume is the outcome of the "Grand Challenge" projects. The papers in this special issue are divided into three sections: (I) Transport and rheological properties, (II) Elasticity, and (III) Phase transitions. Each section of the special issue begins with an introductory paper which reviews recent developments and discusses arising issues presented in the papers of each section. These introductory chapters are written by Dr. S.-i. Karato for the "Transport and Rheological Properties" section, Dr. J.D. Bass for the "Elasticity" section, and Dr. E. Ohtani and Dr. T. Sakai for the "Phase Transition" section, respectively. In the context of these sections, we hope to portray the nature of mineral physics of the Earth's deep mantle, major cutting-edge research results, and to highlight future needs in this discipline.

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