CONTENTS

Preface
Robert D. van der Hilst, Jay D. Bass, Jan Matas, and Jeannot Trampert……vii

Changing Views on the Structure, Composition, and Evolution of Earth's Deep Mantle
Robert D. van der Hilst, Jay D. Bass, Jan Matas, and Jeannot Trampert……..1

Noble Gas Models of Mantle Structure and Reservoir Mass Transfer
Darrell Harrison and Chris J. Ballentine……9

The Survival of Mantle Geochemical Heterogeneities
Francis Albarède……...27

Towards a Quantitative Interpretation of Global Seismic Tomography
Jeannot Trampert and Robert D. van der Hilst……47

Seismic Modeling Constraints on the South African Super Plume
Don V. Helmberger and Sidao Ni……..63

Numerical and Laboratory Studies of Mantle Convection: Philosophy, Accomplishments, and Thermochemical Structure and Evolution
Paul J. Tackley, Shunxing Xie, Takashi Nakagawa, and John W. Hernland……83

Heterogeneous Lowermost Mantle: Compositional Constraints and Seismological Observables
H. Samuel, C.G. Farnetani, and D. Andrault……..101

Numerical Study of the Origin and Stability of Chemically Distinct Reservoirs Deep in Earth's Mantle
P. van Thienen, J. van Summeren, R. D. van der Hilst, A. P. van den Berg, and N. J. Vlaar……117

The Role of Theoretical Mineral Physics in Modeling the Earth's Interior
Mark S. T. Bukowinski and Sofia Akber-Knutson……137

Self-Gravity, Self-Consistency, and Self-Organization in Geodynamics and Geochemistry
Don L. Anderson……..165

The Uncertain Major Element Bulk Composition of Earth's Mantle
Q. Williams and E. Knittle……...187

Highly Siderophile Elements: Constraints on Earth Accretion and Early Differentiation
Kevin Righter…….201

Mantle Oxidation State and Oxygen Fugacity: Constraints on Mantle Chemistry, Structure, and Dynamics
Catherine A. McCammon……..219

Thermochemical State of the Lower Mantle: New Insights From Mineral Physics
James Badro, Guillaume Fiquet, and François Guyot……. 241

Stability of $MgSiO_3$ Perovskite in the Lower Mantle
Sang-Heon Shim……261

Synthetic Tomographic Images of Slabs From Mineral Physics
Y. Ricard, E. Mattern, and J. Matas……..283

Compositional Dependence of the Elastic Wave Velocities of Mantle Minerals: Implications for Seismic Properties of Mantle Rocks
Sergio Speziale, Fuming Jiang, and Thomas S. Duffy……..301

Recent Progress in Experimental Mineral Physics: Phase Relations of Hydrous Systems and the Role of Water in Slab Dynamics
Eiji Ohtani……..321