

CONTENTS

Preface

Steven D. Jacobsen and Suzan van der Leevii

I. Overviews

Nominally Anhydrous Minerals and Earth's Deep Water Cycle

Joseph R. Smyth and Steven D. Jacobsen 1

Seismological Constraints on Earth's Deep Water Cycle

Suzan van der Lee and Douglas A. Wiens 13

II. Water Storage and Stability of Hydrous Phases in the Mantle

Phase Relations of Hydrous Peridotite: Implications for Water Circulation in the Earth's Mantle

Tetsuya Komabayashi 29

Hydrogen Incorporation in Natural Mantle Olivines

Jed L. Mosenfelder, Thomas G. Sharp, Paul D. Asimow, and George R. Rossman 45

Water in Transition Zone and Lower Mantle Minerals

Nathalie Bolfan-Casanova, Catherine A. McCammon, and Stephen J. Mackwell 57

Raman Spectroscopic Studies of Hydrous and Nominally Anhydrous Deep Mantle Phases

Annette K. Kleppe and Andrew P. Jephcoat 69

III. Physical Properties of a Deep Hydrous Mantle

Influence of Water on Major Phase Transitions in the Earth's Mantle

Konstantin D. Litasov, Eiji Ohtani, and Asami Sano 95

Influence of Hydrogen-Related Defects on the Electrical Conductivity and Plastic Deformation of Mantle Minerals: A Critical Review

Shun-ichiro Karato 113

Effect of Water on the Sound Velocities of Ringwoodite in the Transition Zone

Steven D. Jacobsen and Joseph R. Smyth 131

High-Pressure and High-Temperature Stability and Equation of State of Superhydrous Phase B

Toru Inoue, Takayuki Ueda, Yuji Higo, Akihiro Yamada, Tetsuo Irifune, and Ken-ichi Funakoshi 147

Phase Diagram and Physical Properties of H₂O at High Pressures and Temperatures: Applications to Planetary Interiors

Jung-Fu Lin, Eric Schwegler, and Choong-Shik Yoo 159

IV. Observational Constraints on Water in the Deep Mantle

Water Content in the Mantle Transition Zone Beneath the North Pacific Derived From the Electrical Conductivity Anomaly

Takao Koyama, Hisayoshi Shimizu, Hisashi Utada, Masahiro Ichiki, Eiji Ohtani, and Ryota Hae 171

A Water-Rich Transition Zone Beneath the Eastern United States and Gulf of Mexico From Multiple ScS Reverberations

Anna M. Courtier and Justin Revenaugh 181

Low Velocity Zone Atop the Transition Zone in the Western US From S Waveform Triplication

Teh-Ru Alex Song and Don V. Helmberger 195

Mantle Transition Zone Thickness in the Central South-American Subduction Zone

Jochen Braunmiller, Suzan van der Lee, Lindsey Doermann 215

Towards Mapping the Three-Dimensional Distribution of Water in the Upper Mantle From Velocity and Attenuation Tomography

Azusa Shito, Shun-ichiro Karato, Kyoko N. Matsukage, and Yu Nishihara 225

Towards Mapping the Three-Dimensional Distribution of Water in the Transition Zone From P-Velocity Tomography and 660-Km Discontinuity Depths

Daisuke Suetsugu, Toru Inoue, Akira Yamada, Dapeng Zhao, and Masayuki Obayashi 237

Seismic Evidence for Subduction-Transported Water in the Lower Mantle

Jesse F. Lawrence and Michael E. Wysession 251

V. Models of a Deep Water Cycle

Implications of Subduction Rehydration for Earth's Deep Water Cycle

Lars Rüpke, Jason Phipps Morgan, and Jacqueline Eaby Dixon 263

Petrologic Structure of a Hydrous 410 km Discontinuity

Marc M. Hirschmann, Anthony C. Withers, and Cyril Aubaud 277

The Transition-Zone Water Filter Model for Global Material Circulation: Where do we Stand?

Shun-ichiro Karato, David Bercovici, Garrett Leahy, Guillaume Richard and Zhicheng Jing 289