

CONTENTS

1. Generation of High Pressure and Temperature

1.1 Multi-Anvil System

A New High Pressure and High Temperature Apparatus with the Sintered Diamond Anvils for Synchrotron Radiation Use

O. Shimomura, W. Utsumi, T. Taniguchi, T. Kikegawa and T. Nagashima 3

Characterization of Stress, Pressure, and Temperature in SAM85, A DIA Type High Pressure Apparatus
D. J. Weidner, M. T. Vaughan, J. Ko, Y. Wang, X. Liu, A. Yeganeh-Haeri, R. E. Pacalo and Y. Zhao 13

Characterization of Sample Environment in a Uniaxial Split-Sphere Apparatus
R. C. Liebermann and Y. Wang 19

Double-Stage Multi-Anvil System with a Sintered Diamond Anvil for X-Ray Diffraction Experiment at High Pressures and Temperatures

T. Kato, E. Ohtani, N. Kamaya, O. Shimomura and T. Kikegawa 33

High Pressure and High Temperature Generation Using Sintered Diamond Anvils
W. Utsumi, T. Yagi, K. Leinenweber, O. Shimomura and T. Taniguchi 37

A Performance Test for WC Anvils for Multianvil Apparatus and Phase Transformations in Some Aluminous Minerals up to 28 GPa

T. Iriyama, Y. Adachi, K. Fujino, E. Ohtani, A. Yoneda and H. Sawamoto 43

1.2 Diamond Anvil Cell Technique

A Laser Heating System for Diamond Anvil Using CO₂ Laser

T. Yagi and J. Susaki 51

Phase Transitions in a 500 kbar–3000 K Gas Apparatus

R. Boehler and A. Chopelas 55

Hydrothermal Studies in a Diamond Anvil Cell: Pressure Determination Using the Equation of State of H₂O

A. H. Shen, W. A. Bassett and I-M. Chou 61

2. Measurements of Physical and Chemical Properties

Advances in Calorimetric Techniques for High Pressure Phases

L. Topor and A. Navrotsky 71

Experimental Determination of the Electrical Conductivity of the Material of the Earth's Lower Mantle

J.-P. Poirier and J. Peyronneau 77

Characterization of Crystalline and Amorphous Silicates Quenched from High Pressure by ^{29}Si MAS NMR Spectroscopy

M. Kanzaki, J. F. Stebbins and X. Xue 89

Raman Spectroscopy of High Pressure MgSiO_3 Phases Synthesized in a CO_2 Laser Heated Diamond Anvil Cell: Perovskite and Clinopyroxene

A. Chopelas and R. Boehler 101

Raman and Brillouin Scattering Studies of Hydrogen Sulfide at High Pressures up to 23 GPa

H. Shimizu, K. Takasaki and S. Sasaki 109

Polycrystals of High-Pressure Phases of Mantle Minerals: Hot-Pressing and Characterization of Physical Properties

G. D. Gwanmesia and R. C. Liebermann 117

Shock-Compressed State of Powders Characterized by Various In-Situ and Textural Studies

K. Kondo 137

3. Elasticity and Equation-of-State in Relevance to the Earth's Mantle

Differential Finite-Strain Equation of State

R. Jeanloz 147

Elastic Constants, Equations of State and Thermal Diffusivity at High Pressure

J. Zaug, E. Abramson, J. M. Brown and L. J. Slutsky 157

Progress in High-Pressure Ultrasonic Interferometry, the Pressure Dependence of Elasticity of Mg_2SiO_4 Polymorphs and Constraints on the Composition of the Transition Zone of the Earth's Mantle

S. M. Rigden, G. Gwanmesia, I. Jackson and R. C. Liebermann 167

Constraints on Lower Mantle Composition from P - V - T Measurements of $(\text{Fe}, \text{Mg})\text{SiO}_3$ -Perovskite and

$(\text{Fe}, \text{Mg})\text{O}$

R. J. Hemley, L. Stixrude, Y. Fei and H. K. Mao 183

Elasticity and Equation of State of Perovskite: Implications for the Earth's Lower Mantle

D. J. Weidner and Y. Zhao 191

Lateral Variations in Lower Mantle Seismic Velocity

T. S. Duffy and T. J. Ahrens 197

Pressure Derivatives of Elastic Constants of Single Crystal Forsterite

A. Yoneda and M. Morioka 207

Ionic Radius–Bond Strength Systematics, Ionic Compressibilities, and an Application to $(\text{Mg}, \text{Fe})\text{SiO}_3$ Perovskites

Y. Kudoh, C. T. Prewitt, L. W. Finger and E. Ito 215

Elastic Properties of Obsidian, Vitreous SiO_2 and Vitreous GeO_2 under High Pressure up to 6 GPa

K. Suito, M. Miyoshi, T. Sasakura and H. Fujisawa 219

4. High Pressure Behavior of Silicates

4.1 Phase Changes in the Upper Mantle

The Effect of Nonhydrostatic Stress on the $\alpha \rightarrow \beta$ and $\alpha \rightarrow \gamma$ Olivine Phase Transformations
H. W. Green, II, T. E. Young, D. Walker and C. H. Scholz 229

TEM Studies on the Olivine to Modified Spinel Transformation in Mg_2SiO_4
K. Fujino and T. Irifune 237

Phase Transitions in a Komatiite-Rock at High Pressures and High Temperatures
L. C. Ming, M. Madon, M. H. Manghnani and L-J. Wang 245

Effect of Phase Transformations on the Dynamics of the Descending Slab
E. Ito and H. Sato 257

Rheological Structure of a Subduction Zone: Application of High $P-T$ Viscous and Anelastic Properties of Mantle Rocks
H. Sato 263

4.2 Hydrogen in Silicate Minerals

Crystal-Chemistry of High-Pressure Hydrous Magnesium Silicates
C. T. Prewitt and L. W. Finger 269

The System $MgO-SiO_2-CO_2-H_2O$ at High Pressure: A Preliminary Investigation of CO_2 Concentration in Mantle Fluids
T. Katsura and E. Ito 275

Hydrogen Analysis of Mantle Olivine by Secondary Ion Mass Spectrometry
M. Kurosawa, H. Yurimoto, K. Matsumoto and S. Sueno 283

A Vibrational Spectroscopic Study of Hydrogen in High Pressure Mineral Assemblages
Q. Williams 289

A Spectroscopic Study of the High-Pressure Behavior of the O_4H_4 Substitution in Garnet
E. Knittle, A. Hathorne, M. Davis and Q. Williams 297

4.3 Melting and Elemental Partition

Exchange of Fe^{2+} and Mg^{2+} between Olivine and Clinopyroxene at 7.5 GPa and 1300 °C
T. Kawasaki and E. Ito 305

Melting of Ferromagnesian Silicates under the Lower Mantle Conditions
E. Ito and T. Katsura 315

High Pressure Melting of Pyrolite under Hydrous Condition and Its Geophysical Implications
T. Inoue and H. Sawamoto 323

Shock Recovery Experiments on Chondritic Materials
M. Kitamura, A. Tsuchiyama, S. Watanabe, Y. Syono and K. Fukuoka 333

Partitioning of Elements between Mantle and Core Materials and Early Differentiation of the Earth
E. Ohtani, T. Kato, K. Onuma and E. Ito 341

5. Core and Planetary Materials

Hugoniot Sound Velocities in Metals with Applications to the Earth's Inner Core
T. S. Duffy and T. J. Ahrens 353

High-Pressure Crystal Structure and Equation of State of Iron Hydride: Implications for the Earth's Core
J. V. Badding, H. K. Mao and R. J. Hemley 363

Some Properties of the Fe-H System at High Pressures and Temperatures, and Their Implications for the Earth's Core
Y. Fukai 373

Properties of Planetary Fluids at High Shock Pressures and Temperatures
W. J. Nellis, A. C. Mitchell, N. C. Holmes and P. C. McCandless 387

Modern Models of Giant Planets
V. N. Zharkov and T. V. Gudkova 393

Equation of State and Insulator-Metal Transition of Ice under Ultra-High Pressures
J. Hama, K. Suito and M. Watanabe 403

High Pressure Study of Diamond, Graphite and Related Materials
I. V. Aleksandrov, A. F. Goncharov, E. V. Yakovenko and S. M. Stishov 409

A New Behavior of Carbon under Shock Compression: Rapid-Quenching of Two New Crystalline Carbon Forms
H. Hirai and K. Kondo 417

6. Phase Transition

6.1 Theory

First Principles Predictions of Elasticity and Phase Transitions in High Pressure SiO₂ and Geophysical Implications
R. E. Cohen 425

Molecular Dynamics Study of Rutile-CaCl₂-Type Phase Transition of SiO₂
Y. Matsui and S. Tsuneyuki 433

Pressure-Induced Phase Transitions in Rutile-Type Crystals
Y. Yamada, S. Tsuneyuki and Y. Matsui 441

6.2 Experiments

High-Pressure High-Temperature Stability of α PbO₂-Type TiO₂ and MgSiO₃ Majorite: Calorimetric and *In Situ* X-Ray Diffraction Studies
M. Akaogi, K. Kusaba, J. Susaki, T. Yagi, M. Matsui, T. Kikegawa, H. Yusa and E. Ito 447

Baddeleyite-Type High-Pressure Phase of TiO₂ and Its Stable *P-T* Region
S. Endo, H. Sato, J. Tang, Y. Nakamoto, T. Kikegawa, O. Shimomura and K. Kusaba 457

Phase Transformation of Baddeleyite (ZrO_2) to an Orthorhombic Phase: Structural Analysis of Ortho- ZrO_2
by Neutron Diffraction

O. Ohtaka, T. Yamanaka, S. Kume, N. Hara, H. Asano and F. Izumi 463

Pressure-Induced Phase Transition in Rare Earth Sesquioxides

T. Atou, K. Kusaba, Y. Syono, T. Kikegawa and H. Iwasaki 469

High Pressure Electrical Resistance of Zr and FeF_2 through Structural Transformations

R. A. Secco, M. H. Manghnani, L. C. Ming, X. Li and J. A. Xu 477

6.3 Amorphization

Spectroscopic and X-Ray Diffraction Studies of Metastable Crystalline-Amorphous Transitions in $\text{Ca}(\text{OH})_2$
and Serpentine

C. Meade, R. Jeanloz and R. J. Hemley 485

Pressure Induced Amorphization of Hexagonal GeO_2

T. Yamanaka, T. Shibata, S. Kawasaki and S. Kume 493

Pressure Induced Collapse of the Tetrahedral Framework in Crystalline and Amorphous GeO_2

G. H. Wolf, S. Wang, C. A. Herbst, D. J. Durben, W. F. Oliver, Z. C. Kang and K. Halvorson 503

High Pressure Raman Study of $\text{TiO}_2\text{-SiO}_2$ Glasses: Evidence of the Structural Change

J. Xu, M. H. Manghnani, L. C. Ming and S. Wang 519

Author Index 527

Index 529