

Table of Contents

Map of Kurayoshi City	i
Bus time table	iii
Scientific Program	iv
 Abstracts of Papers	 v
 1 Imaging the mantle	 1
1.1 Yoshio Fukao: The upper and lower mantle transition region as temporal reservoirs of subducted slabs and rising plumes	3
1.2 Guy Masters, Gabi Laske: Seismological constraints on geochemical reservoirs? . .	4
1.3 Mamoru Kato ¹ , and Hitoshi Kawakatsu ² : Seismological <i>in situ</i> estimation of density jumps across the transition zone discontinuities beneath Japan	5
1.4 Hitoshi Kawakatsu: Seismic discontinuities/scatterers in the lower mantle	6
1.5 Frank D. Stacey: Thermal vs compositional interpretations of lower mantle tomography	7
1.6 Dapeng Zhao: A new global tomography of the earth: structure of mantle plumes . .	8
 2 Formation and evolution of geochemical reservoirs	 9
2.1 Stanley R. Hart: Formation and evolution of geochemical mantle domains	11
2.2 M. Hirschmann ¹ , T. Kogiso ¹ , and Daniel J. Frost ² : A petrologic view of the characteristics of mantle geochemical reservoirs	13
2.3 Ian H. Campbell: The relationship between continental and oceanic crust formation and the development of the depleted mantle	15
2.4 P.R. Castillo ^{1*} , R.U. Solidum ^{1,2} , and R.S. Punongbayan ² : Origin of high-Nb basalts from the Sulu Arc, southern Philippines	16
2.5 Takeshi Hanyu*, Tibor J. Dunai, Gareth R. Davies, Ichiro Kaneoka, Susumu Nohda, and Kozo Uto: Evidence for distinct primitive mantle sources; a noble gas study of the Reunion hotspot	17
2.6 Manuel Moreira: Noble gases and the primitive reservoir	18
2.7 Katsura Kobayashi and Eizo Nakamura: Geochemical evolution of Akagi volcano, northeast Japan: implications for interaction between island arc magma and lower crust, and generation of isotopically variable magmas.	21
2.8 Katsura Kobayashi ¹ , Takuya Moriguti ¹ , Ryoji Tanaka ¹ , Kenji Shimizu ² , Eizo Nakamura ¹ : Analytical procedure for the measurement of lithium and boron isotope composition by High Resolution Secondary Ion Mass Spectrometer and its Application	22
2.9 Takeshi Kuritani and Eizo Nakamura: A simple method for precise isotope analysis of ng-level Pb for natural rock samples	23
2.10 Naoko Matsumoto* and Masao Kitamura: Chemical compositions of a binary dilute solid solution during growth	24
2.11 Takuya Moriguti and Eizo Nakamura: Precise Li isotope analysis by thermal ionization mass spectrometry (TIMS) using lithium phosphate as an ion source material and highly-yield lithium separation from natural samples	25
2.12 Takuya Moriguti and Eizo Nakamura: Li-B-Pb isotope systematic study of Izu arc volcanic rocks: implications for crust-mantle recycling at subduction zone	26

2.13	Takuya Moriguti and Eizo Nakamura: Li isotope variation in quaternary basaltic rocks in northeastern Japan arc	27
2.14	Chie Sakaguchi and Eizo Nakamura: Chemical and isotopic evolution of the Allende meteorite	29
2.15	K. Shimizu ^{1*} , E. Nakamura ¹ , and S. Maruyama ² : Petrology, geochemistry and garnet and pyroxene xenocrysts of Belingwe volcanics, Zimbabwe - indisputable evidence for crustal contamination	30
2.16	Hiroyuki Takei, Tetsuya Yokoyama, Akio Makishima and Eizo Nakamura: Formation and suppression of AlF_3 during HF digestion of rock samples in Teflon bomb for precise trace element analyses by ICP-MS and ID-TIMS	32
2.17	Hiroyuki Takei and Eizo Nakamura: Origin of the ore-forming fluids in the Hishikari gold deposits.	33
2.18	Tetsuya Yokoyama, Akio Makishima, Eizo Nakamura: Evaluation of coprecipitation of incompatible trace elements with fluoride during silicate rock dissolution by acid digestion	35
2.19	Tetsuya Yokoyama, Akio Makishima, Eizo Nakamura: Separation of thorium and uranium from silicate rock samples using two commercial extraction chromatographic resins	37
2.20	Tetsuya Yokoyama, Akio Makishima, Eizo Nakamura: Precise analysis of $^{234}\text{U}/^{238}\text{U}$ ratio using UO_2^+ ion with TIMS	39
2.21	Tetsuya Yokoyama, Eizo Nakamura: Precise determination of ferrous iron in silicate rocks	41
2.22	Tetsuya Yokoyama, Katsura Kobayashi, Takeshi Kuritani, Eizo Nakamura: Mantle metasomatism and rapid melt ascent beneath Miyakejima volcano: evidence from ^{238}U - ^{230}Th disequilibrium	43
2.23	Tomohiro Usui ¹ , Eizo Nakamura ¹ , Katsura Kobayashi ¹ , Shigenori Maruyama ² and Herwart Helmstaedt ³ : Petrology and trace element geochemistry of eclogite xenoliths from the Colorado Plateau	46
2.24	Tomohiro Usui, Katsura Kobayashi and Eizo Nakamura: Preparation of reliable zircon standard for U-Pb dating method by HR-SIMS	47
2.25	Eizo Nakamura and Toshio Nakano: Trace element migration associated with evolution of metamorphic fluid during subduction zone-related metamorphism	49
2.26	Eizo Nakamura, Masaaki Tanimoto, Takeshi Kuritani and Masako Yoshikawa: Geochemical evolution of the Horoman peridotite complex revised by incorporation of lead isotope systematics: Implications for melt extraction, metasomatism, and compositional layering in the mantle	50
2.27	Gray E. Bebout ¹ , and Eizo Nakamura: Record in metamorphic tourmalines of subduction-zone devolatilization and boron cycling	51
2.28	Toshio Nakano and Eizo Nakamura: Boron isotope geochemistry of metasedimentary rocks and tourmalines in a subduction-zone metamorphic suite	53
2.29	Akio Makishima, Mayumi Nakanishi and Eizo Nakamura: Simultaneous determination of Ru, Pd, Re, Os, Ir and Pt contents and $^{187}\text{Os}/^{188}\text{Os}$ ratios in geological samples using a new anion exchange chromatographic procedure	54
2.30	Estelle F. Rose, A. Makishima, E. Nakamura: Major and rare earth elements geochemistry of the Icelandic Plume: an island-wide approach for source determination	55
2.31	Sophie Alves ¹ , Pierre Schiano ² , Bernard Bourdon ³ , Claude J. Allègre ³ : Magma formation at Saba Island, Lesser Antilles: a numerical model for mantle wedge-slab mixing according to osmium data	57

3 High pressure mineral physics 59

3.1	Takehiko Yagi: Developments and problems in laboratory high pressure experiments	61
3.2	Eiji Ito: Recent developments in high pressure mineral physics experiments using sintered diamond anvils	61
3.3	Hitoshi Yamada ¹ , Tomoo Katsura ¹ , Toru Shinmei ¹ , Atsushi Kubo ¹ , Osamu Nishikawa ¹ , Maoshuang Song ¹ , Eiji Ito ¹ , Kenichi Funakoshi ² : In situ determination of the olivine-modified spinel phase boundary in the system Mg_2SiO_4 - Fe_2SiO_4	61
3.4	Masaki Akaogi ^{1*} , Akira Tanaka ¹ , and Eiji Ito ² : Garnet-ilmenite-perovskite transitions in the system $\text{Mg}_4\text{Si}_4\text{O}_{12}$ - $\text{Mg}_3\text{Al}_2\text{Si}_3\text{O}_{12}$: phase equilibria, calorimetry and application to the mantle	63
3.5	Masanori Matsui: MD simulation of the density and P- and S-wave velocity jumps across the 410km and 660km seismic discontinuities	66
3.6	Kiyoshi Fujino ^{1*} , Nobuyoshi Miyajima ¹ , Yohei Sasaki ¹ , Reki Odawara ¹ , Hisayuki Ogawa ¹ , Nagayoshi Sata ² , Takehiko Yagi ² : Mineralogy of the lower mantle by the combined method of a laser-heated diamond anvil cell experiment and analytical transmission electron microscopy	67
3.7	S. Ono ¹ , E. Ito ² : Mineralogy of subducted basaltic crust (MORB) in the lower mantle	69
3.8	Tetsuo Irifune*, Yuichiro Sueda, Takeshi Sanehira, Hisanobu Naka, Toru Inoue, Yuji Higo, Takayuki Ueda, Ken-ichi Funakoshi, and Wataru Utsumi: In situ X-ray diffraction measurements for some mantle minerals to 40 GPa using a combination of synchrotron radiation and multianvil apparatus with sintered diamond anvils	71
3.9	Atsushi Kubo, Eiji Ito, Tomoo Katsura, Toru Shinmei, Hitoshi Yamada, Osamu Nishikawa, Maoshuang Song, Kenichi Funakoshi: Exploration of β -Fe using sintered diamond anvils	72
3.10	Satoru Urakawa*, Masayuki Hasegawa, Junji Yamakawa, Ken-ichi Funakoshi, Wataru Utsumi: High-pressure phase relationships of FeS	75
3.11	Yoshitaka Aizawa: Experimental determination of compressional wave velocity of olivine aggregate at 1 GPa up to 1273 K	76
3.12	N. Mayama*, I. Suzuki, T. Katsura, A. Yoneda, I. Ohno: Temperature dependence of elastic moduli of polycrystalline wadsleyite and ringwoodite	77
3.13	Takaya Nagai, Koichi Kittaka, Takamitsu Yamanaka: X-ray diffraction study of CaO at high pressure and temperature: equation of state of CaO	78
3.14	Yu Nishihara, Eiichi Takahashi, Tomohiro Iguchi, Keisuke Nakayama, Kyoko Matsukage, Miki Shirasaka and Takumi Kikegawa: Thermal equation of state of an omphacite	79
3.15	Naohisa Hirao, Tadashi Kondo, Eiji Ohtani, and Takumi Kikegawa: Static compression of Fe-Si alloy	80
3.16	Taku Tsuchiya and Katsuyuki Kawamura: Theoretical estimations of contribution of electrons to the thermal expansion of Au and Pt metals	81
3.17	Masahiro Osako ¹ , Eiji Ito ² and Akira Yoneda ² : Thermal diffusivity and thermal conductivity of olivine and garnet under pressures up to 8 GPa and at temperatures up to 1000 K	83
3.18	Akira Yoneda: Non-hydrostatic thermodynamics of anisotropic materials: geological implications for pressure solution	86
3.19	Christian Holzapfel ¹ , D.C. Rubie ¹ , S. Chakraborty ² , F. Langenhorst ¹ , D.J. Frost ¹ : Rates of cation diffusion in olivine and silicate perovskite under mantle conditions .	88
3.20	KT Koga, MJ Walter, E Nakamura, and K Kobayashi: Carbon self-diffusion in diamond	90
3.21	Osamu Nishikawa: Stored strains and boundary characters of dynamically recrystallized quartz aggregates	92
3.22	Masami Kanzaki: In-situ observation of plastic deformation at high pressure and temperature: A preliminary study	93

3.23	D. Sakamoto*, A. Yoshiasa, O. Ohtaka, T. Yamanaka and K. Ota: Conduction mechanism of fayalite and gamma-Fe ₂ SiO ₄ : electrical conductivity jump by olivine-spinel transition	95
3.24	Nobuyoshi Miyajima ¹ , Falko Langenhorst ¹ , Daniel Frost ¹ , Dave Rubie ¹ and Takehiko Yagi ² : Electron energy-loss spectroscopy of garnet-perovskite high-pressure assemblages	96
3.25	X. Xue*, T. Kawamoto, M. Kanzaki: NMR evidence for a new water dissolution mechanism in depolymerized silicate melts: results for hydrous diopside composition	99
3.26	X. Xue and M. Kanzaki: Ab initio calculation of the ¹⁷ O and ¹ H NMR parameters for various OH groups: Implications to the speciation and dynamics of dissolved water in silicate glasses	100
3.27	T. Tsujimura ⁽¹⁾ , X. Xue ⁽²⁾ , M. Kanzaki ⁽²⁾ , A. Kitakaze ⁽¹⁾ and Y. Kudoh ⁽¹⁾ : The effect of sulfur on silicate network structure in sodium silicate glasses	101
3.28	Shigeru Yamashita: Water speciation in basaltic melts: constraints from water solubility measurements	102
3.29	Tomohiro Iguchi*, Eiichi Takahashi, Yu Nishihara: Pressure dependence of the emf of thermocouples: Comparison of W-Re and Pt-Rh thermocouples with P-measurements by in situ X-ray	103
3.30	M. Song ¹ , K. Aoki ² , H. Yamawaki ² , H. Fujihisa ² , and M. Sakashita ² : Infrared Observation on Low Temperature Phase Transformations of Ice	104
4	Dehydration of subducting slabs and water storage in the mantle	107
4.1	Max W. Schmidt: Dehydration vs. melting vs. dissolution: Where and how to generate a mobile component during subduction	109
4.2	Eiji Ohtani: Circulation and Redistribution of Water in the Earth's Interior	111
4.3	Ganesha Atni Venkatramiah, J.A.K. Tareen: An experimental study on the Mg-Al granulites and production of granitic melts in K ₂ O-MgO-Al ₂ O ₃ -SiO ₂ -H ₂ O system	112
4.4	Harry W. Green, II: Earthquakes at depth, their enabling mineral reactions, and transport of H ₂ O into the deep mantle	114
4.5	Dapeng Zhao: Slab dehydration and earthquakes: Seismological evidence	116
4.6	Hikaru Iwamori: Transportation of H ₂ O and melting in subduction zones	117
4.7	Tomoaki Morishita*, Shoji Arai, Akihiro Tamura: Apatite concentration in the Finero phlogopite-peridotite, Italian Western Alps, as the late product of subduction-related mantle metasomatism	118
4.8	Hiroyuki Kagi: High internal pressure retained in fluid inclusions of mantle-derived materials	120
4.9	Tatsuhiko Kawamoto and Kyoko Matsukage: In situ observation of supercritical behaviors between H ₂ O fluids and subduction zone magmas.	121
4.10	Robert P. Rapp ¹ and N. Shimizu: Geochemical Consequences of Deep Subduction of Oceanic Crust: Insights from Melting Experiments on Hydrous Metabasalt at 3-16 GPa	122
4.11	Miki Shirasaka and Eiichi Takahashi: The fate of subducted carbonate within oceanic crusts	124
4.12	Joseph R. Smyth ^{1*} , Daniel J. Frost ² : An Experimental Study of the Effect of Water on the 410-km Discontinuity	126
4.13	Toru Inoue ^{§*} , Yuji Higo [†] , Takayuki Ueda [†] , Yasutika Tanimoto [†] and Tetsuo Irifune [§] : The effect of water on the high-pressure phase boundaries in the system Mg ₂ SiO ₄ -Fe ₂ SiO ₄	128
4.14	G.C.M Richard*, M. Monnereau: Is the transition zone a water reservoir ?	130
4.15	Motohiko Murakami*, Kei Hirose, Hisayoshi Yurimoto, Satoru Nakashima: Solubility of water in lower mantle minerals	132

4.16	Tomoo Katsura ¹ , Kiyoshi Fujita ² , and Keishi Shinoda ³ : Electrical conductivity of hydrous materials at high pressures and high temperatures.	133
5	Magmatic differentiation and the evolution of the mantle and core	135
5.1	E. Takahashi ¹ , K. Nakajima ¹ , R. Takeguchi ¹ , K. Shinozaki ¹ , Ren Zhang-Young ¹ , R. Tanaka ² and E. Nakamura ² : Melt Generation in the Hawaiian Plume	137
5.2	B.J. Wood: Mantle composition and conditions of core formation	140
5.3	Takeshi Kuritani: Boundary layer fractionation constrained by differential information from the Kutsugata lava flow, Rishiri Volcano, Japan	141
5.4	Ulrich Faul: Constraints on Porosity in Partially Molten Regions in the Upper Mantle from Permeability Measurements and U-series Modeling	142
5.5	Ryoji Tanaka and Eizo Nakamura: Evidence for slab tear and the related magmatism beneath the northwestern El Salvador, Central America	144
5.6	Ryoji Tanaka ¹ , Eizo Nakamura ¹ , Eiichi Takahashi ² : Geochemical evolution of Koolau Volcano, Hawaii	145
5.7	Masaaki Obata*, Eiichi Takazawa: A possible discontinuous behavior of melt percolation in partially molten mantle and its implication to compositional layering in orogenic lherzolites.	146
5.8	Yuki Asahara, Eiji Ohtani: The role of water in generation of komatiite magma . . .	147
5.9	Eizo Nakamura ¹ , Toshihiro Suzuki ² , Katsura Kobayashi ¹ , Akio Makishima ¹ and Masaki Akaogi ² : Determination of trace element partitioning between majorite and silicate melt in the primitive mantle composition at pressure of 15 GPa	148
5.10	E. Ito, A. Kubo, T. Katsura, and M. J. Walter: Melting of peridotite under lower mantle conditions and its implication to differentiation of a deep magma ocean . . .	150
5.11	M. Walter: Core formation in a reduced magma ocean: new constraints from W, P, Ni and Co	152
5.12	D.C. Rubie ¹ , C. Holzappel ¹ , J. Reid ¹ , S. Fortenfant ¹ , H.J. Melosh ² , B.T. Poe ¹ , D.J. Frost ¹ , K. Righter ² : Mechanisms of metal transport during formation of the earth's core: constraints from the kinetics of metal-silicate reactions	154
5.13	H. Terasaki ¹ , T. Kato ¹ , S. Urakawa ² , K. Funakoshi ³ , A. Suzuki ⁴ , K. Sato ⁵ , M. Hasegawa ² : Effect of Light Elements on Viscosity of Liquid Iron-Alloy	156
5.14	Takashi Yoshino, Michael J. Walter and Tomoo Katsura: Critical melt fraction for percolation of core-forming materials	158
5.15	Tadahiro Hatakeyama and Masaru Kono: Geomagnetic field model for the last 5 my and conditions at core-mantle boundary	160
6	Future Perspectives	161
6.1	Ho-kwang Mao: Future perspectives on high-pressure experimental geophysics and geochemistry	163
6.2	Dave Rubie: Title to be announced	163
6.3	S. Honda ¹ and M. Yoshida ² : Mantle convection as a tool for understanding the links among the various geological phenomena	163
6.4	Takamitsu Yamanaka*, A. Yoshiasa, O. Otaka and N. Nagai: High-pressure crystallography in mineral physics	165
6.5	Masaru Kono: Dynamo process in the core under varying energy flow conditions . .	167
6.6	Eizo Nakamura, Akio Makishima, Takuya Moriguti, Katsura Kobayashi, Chie Sakaguchi, Tetsuya Yokoyama, Ryoji Tanaka, Takeshi Kuritani & Hiroyuki Takei: Comprehensive geochemical analyses of extremely small amounts of terrestrial and extraterrestrial materials for sample-return missions	168

6.7	Akio Makishima, Mayumi Nakanishi and Eizo Nakamura: Simultaneous determination of Ru, Pd, Re, Os, Ir and Pt contents and $^{187}\text{Os}/^{188}\text{Os}$ ratios in geological samples using a new anion exchange chromatographic procedure	169
6.8	Katsura Kobayashi, Tomohiro Usui and Eizo Nakamura: Zircon age dating by dynamic multi-collection method using high resolution secondary ion mass spectrometer	170
List of Participants		172

Front cover: The National Treasure “Nageire-do” in Misasa Town built in 8th century on a precipitous flank of Mt. Mitoku-san.