S.-H. Dan Shim | Curriculum Vitae

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Degrees

2001: **Ph.D. Geosciences**, Princeton University, Princeton, New Jersey, USA.
Thesis Adviser: Dr. Thomas S. Duffy

1994: **M.S. Geological Sciences**, Seoul National University, Seoul, Korea.
Thesis Adviser: Drs Soo Jin Kim and Jung Ho Ahn

1992: **B.S. Geological Sciences**, Seoul National University, Seoul, Korea.

Academic Appointments

2021–present: **Professor**, School of Earth and Space Exploration, Arizona State University, USA.

2022–2025: **Navrotsky Professor of Materials Research**, College of Liberal Arts and Sciences, Arizona State University, USA.

2012–2021: **Associate Professor**, School of Earth and Space Exploration, Arizona State University, USA.

2015–present: **Honors Faculty**, Barrett Honors College, USA.

2019: **Visiting Professor**, Yonsei Frontier Lab program, Yonsei University, Seoul, Korea.

2014: **Visiting Researcher**, Institut de Physique du Globe de Paris (IPGP), Paris, France.

2008–2011: **Associate Professor of Experimental Geophysics**, Massachusetts Institute of Technology, USA.

2003–2008: **Assistant Professor of Experimental Geophysics**, Massachusetts Institute of Technology, USA.

2001–2003: **Miller Research Fellow**, University of California at Berkeley, USA.

Research Interests

Mineralogy of Earth, solar-system planets, and exoplanets. Structure and dynamics of the deep planetary interiors. Magma ocean and early evolution of planets. Interaction between atmosphere and interior. Hydrogen storage and transport in the deep interiors of planets. Structure and dynamics of exoplanets (super-Earths, sub-Neptunes, gas giants, and waterworlds). Materials behavior during planet formation. In-situ measurements of crystal structures, chemical reactions, equations of states, and physical properties in diamond-anvil cell using synchrotron X-ray techniques. Application of X-ray free electron laser techniques for high-pressure research. Development of new materials at high pressures and high temperatures. Hydrogen storage in materials with naturally abundant elements.

Honors

2023: Fellow of Mineralogical Society of America

2022–2025: Navrotsky Professorship, Arizona State University

2017: Nomination for the College of Liberal Arts and Sciences Zebulon Pearce Distinguished Teaching Award, Arizona State University

2010: Doornbos Memorial Prize, Studies of the Earth's Deep Interior, International Union of Geodesy and Geophysics (IUGG)

2004: Jeptha H. and Emily V. Wade Award, Massachusetts Institute of Technology

2001–2003: Miller Research Fellowship, University of California, Berkeley

2001: Graduate Research Award, Mineral and Rock Physics Section, American Geophysical Union (AGU)

2000: Outstanding Student Paper Award, Tectonophysics Section, American Geophysical Union (AGU)

2000–2001: Charlotte Elizabeth Procter Fellowship, Princeton University

1999–2000: Research Board Tuition Award, Princeton University

1999: Travel Grant, Association of Princeton Graduate Alumni, Princeton University

1996: Hess Fellowship, Department of Geosciences, Princeton University

1992: Top-Honors Graduate, College of Natural Sciences, Seoul National University

Professional Network

GoogleScholar: Shim's records on publication and citations

ORCID: Shim's research digital identifier, 0000-0001-5203-6038

GitHub: Shim's open source code and software repository

ResearchGate: Shim's publication list with pre-, re-, and post-prints

Membership

American Association for the Advancement of Science

American Astronomical Society

American Geophysical Union

Mineralogical Society of America

Recent Research Collaborations (2022–2025)

ASU: E. Garnero and M. Li (structure of the mantle), K. Leinenweber, T. Sharp, D. Smith, A. Navrotsky, and K. Tsuno (multi-anvil press), P. Buseck (electron microscopy), J. O'Rourke (Mars interior; Earth's core)

US: E. Alp (Advanced Photon Source), M. Kunz (Advanced Light Source), W. Mao, A. Gleason, R. Alonso-Mori (Stanford University), V. B. Prakapenka (GSECARS, University of Chicago), D. Stegman (University of California, San Diego), S. Yang (Yale University), S. Tracy, P. Driscoll (Carnegie Institution), I. Oleynik (University of South Florida), S. Hansen (University of Alabama)

International: Y. J. Lee (Yonsei University, Korea), G. Morard (Université Grenoble Alpes, France), A. Ravasio (Sorbonne Université, France), S. Speziale (GeoForschungsZentrum Potsdam, Germany), A. Vazan (Open University of Israel)

Technical Skills

Laser-heated diamond-anvil cell and multi-anvil press

X-ray diffraction and crystal structure refinement

Dispersive- and gated-Raman spectroscopy

Transmission electron microscopy

Synchrotron X-ray diffraction and spectroscopy: Advanced Photon Source (Argonne National Laboratory), Advanced Light Source (Lawrence Berkeley National Laboratory), National Synchrotron Light Source (Brookhaven National Laboratory), Cornell High Energy Synchrotron Source (Cornell University), and Stanford Synchrotron Radiation Laboratory (Stanford University)

X-ray Free Electron Laser: Linac Coherent Light Source (LCLS) at Stanford Linear Accelerator Center (SLAC) National Accelerator Laboratory, and Pohang Accelerator Laboratory X-ray Free Electron Laser (PAL-XFEL)

Computer programming with Python, FORTRAN, IDL, and C languages and Jupyter in UNIX, Linux, Windows, and Mac OS X systems

Publication

Authorship: The authors from the Shim group are in bold with the following notations:

PI: Shim as the principal investigator
cPI: Shim as a co-principal investigator
UG: Undergraduate students
GS: Graduate students
vGS: Visiting graduate students
PD: Postdocs

Tags: Shim's recent developments are highlighted with the following symbols.

Solar-system planets and exoplanets
Technical developments
Educational developments

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Published Articles

100. **X. Wei**[GS], S. Chariton, V. B. Prakapenka, Y. Fei, and **S.-H. Shim**[PI]. Effects of hydrogen on Fe–S alloys and their implications for the Martian core. Journal of Geophysical Research: Planets, DOI: 10.1029/2025JE009217, 2026.

99. Y. Zhang, K. Bali, C. Dorn, A. Ravasio, H. Yang, S. Pandolfi, A, Chen, **X. Wei**[GS], L. Libon, Q. Che, D. Zheng, E. Boulard, A. Benuzzi-Mounaix, H. J. Lee, E. Galtier, N. A. Czapla, D. Sokaras, R. Alonso-Mori, A. Gleason, **S.-H. Shim**[cPI], G Morard, and W. L. Mao. Shock compression of FeOOH and implications for iron-water interactions in super-Earth magma oceans. Nature Communications, DOI: 10.1038/s41467-025-67845-8, 2025.

98. W.-Y. Zhou, M. Hao, W. Su, **T. Kim**[PD], **S. Chen**[PD], **S.-H. Shim**, D. Zhang, P. Q. H. Nguyen, K. Armstrong, and J. S. Zhang. Elasticity of davemaoite as a primary contributor to lower-mantle heterogeneities. Science, DOI: 10.1126/science.adx8356, 2025.

97. **H. Horn**[GS], A. Vazan, S. Chariton, V. Prakapenka, and **S.-H. Shim**[PI]. Building wet planets via high-pressure magma-hydrogen reactions. Nature, DOI: 10.1038/s41586-025-09630-7, 2025.

96. G. Morard, J.-A. Hernandez, C. Pege, C. Nagy, L. Libon, A. Lacquement, D. Sokaras, H. J. Lee, E. Galtier, P. Heimann, E. Cunningham, S. Glenzer, T. Vinci, C. Prescher, S. Boccato, J. Chantel, S. Merkel, Y. Zhang, H. Yang, **X. Wei**[GS], S. Pandolfi, W. L. Mao, A. E. Gleason, **S.-H. Shim**, R. Alonso-Mori, and A. Ravasio. Structural evolution of liquid silicates under conditions in super-Earth interiors. Nature Communications, DOI: 10.1038/s41467-024-51796-7, 2024.

95. K. Tsuno, D. S. Grewal, V. Xu, L. Leinbach, K. Leinenweber, A. Wittmann, and **S.-H. Shim**. The effect of nitrogen on the dihedral angle between Fe–Ni melt and ringwoodite: implications for the nitrogen deficit in the bulk silicate Earth. Geophysical Research Letters, DOI: 10.1029/2024GL109584, 2024.

94. K. J. Agboola, S. E. Hansen, E. J. Garnero, S. Rost, M. Li, **S.-H. Shim**. Ultra-low velocity zones beneath the Southern Hemisphere imaged with double-array stacking of *PcP* waveforms. Journal of Geophysical Research: Solid Earth, DOI: 10.1029/2023JB028170, 2024.

93. **T. Kim**[PD], **X. Wei**[GS], S. Chariton, V. Prakapenka, Y.-J. Ryu, S. Yang, and **S.-H. Shim**[PI]. Stability of hydrides in sub-Neptune exoplanets with thick hydrogen-rich atmospheres. Proceedings of the National Academy of Sciences, DOI: 10.1073/pnas.2309786120, 2023.
Press release: ASU News

92. **T. Kim** [vGS], J. Lee, S. Chariton, V. Prakapenka, R. Husband, N. Giordano, H.-P. Liermann, **S.-H. Shim** [cPI], and Y. Lee. Impact of deeply subducted water on the origin of the E' layer in the core. Nature Geosciences, DOI: 10.1038/s41561-023-01324-x, 2023.
Press release: ASU News

91. **S.-H. Shim** [cPI], **B. Ko** [GS], D. Sokaras, B. Nagler, H. J. Lee, E. Galtier, S. Glenzer, E. Garanados, T. Vinchi, G. Fiquet, **J. Dolinschi** [UG], **J. Tappan** [UG], **B. Kulka** [UG], W. L. Mao, G. Morard, A. Ravasio, A. E. Gleason, and R. Alonso-Mori. Ultrafast X-ray detection of low spin iron in molten silicate at deep planetary interior conditions. Science Advances, DOI: 10.1126/sciadv.adi6153, 2023.
Press release: ASU News, Phys.org

90. **S. Fu** [PD], S. Chariton, V. B. Prakapenka, and **S.-H. Shim** [PI]. Hydrogen and silicon effects on hexagonal close packed Fe alloys at high Pressure: Implications for the composition of Earth's inner core. Journal of Geophysical Research, DOI: 10.1029/2022JB026016, 2023.

89. S. E. Hansen, E. J. Garnero, M. Li, **S.-H. Shim**, and S. Rost. Globally distributed subducted materials along the Earth's core-mantle boundary: Implications for ultralow velocity zones. Science Advances, DOI: 10.1126/sciadv.add4838, 2023.
Press release: University of Alabama News, ASU News, Phys.org, BBC News, NSF Research News

88. **H. Piet** [PD], A. V. G. Chizmeshya, B. Chen, S. Chariton, E. Greenberg, V. B. Prakapenka, P. R. Buseck, **S.-H. Shim** [PI]. Superstoichiometric alloying of H and close-packed FeNi under high pressures: Implications for hydrogen storage in planetary cores. Geophysical Research Letters, DOI: 10.1029/2022GL101155, 2023.

87. **S. Fu** [PD], S. Chariton, V. B. Prakapenka, and **S.-H. Shim** [PI]. Core origin of seismic velocity anomalies at the Earth's core-mantle boundary. Nature, DOI: 10.1038/s41586-023-05713-5, 2023.
Press release: ASU News, Science Highlights - The Advanced Photon Source, VICE, Argonne National Laboratory Press Release

86. **H. Horn** [GS], V. Prakapenka, S. Chariton, S. Speziale, and **S.-H. Shim** [PI]. Reaction between hydrogen and ferrous/ferric oxides at high pressures and high temperatures – implications for sub-Neptunes and super-Earths. Planetary Science Journal, DOI: 10.3847/PSJ/acab03, 2023.

85. **S. Fu** [PD], S. Chariton, V. B. Prakapenka, A. Chizmeshya, and **S.-H. Shim** [PI]. Hydrogen solubility in FeSi alloy phases at high pressures and temperatures. American Mineralogist, DOI: 10.2138/am-2022-8295, 2022.

84. **B. Ko** [GS], E. Greenberg, V. Prakapenka, E. Alp, W. Bi, Y. Meng, D. Zhang, and **S.-H. Shim** [PI]. Calcium dissolution in bridgmanite in the Earth's deep mantle. Nature, DOI: 10.1038/s41586-022-05237-4, 2022.
Press release: ASU News, Phys.org

83. **B. Ko** [GS], S. Chariton, V. Prakapenka, B. Chen, E. J. Garnero, M. Li, and **S.-H. Shim** [PI]. Water-induced diamond formation at Earth's core-mantle boundary. Geophysical Research Letters, DOI: 10.1029/2022GL098271, 2022.
Press release: ASU News, Newsweek

82. **S. Fu** [PD], S. Chariton, V. B. Prakapenka, A. Chizmeshya, and **S.-H. Shim** [PI]. A new hexagonal ternary alloy phase stable in Fe-Si-H at 28.6–42.2 GPa and 3000 K. Physical Review B, DOI: 10.1103/PhysRevB.105.104111, 2022.

81. **S.-H. Shim** [PI], A. Chizmeshya, and K. Leinenweber. Water in the crystal structure of $CaSiO_3$ perovskite. American Mineralogist, DOI: 10.2138/am-2022-8009, 2022.

80. **H. Piet** [PD], A. V. G. Chizmeshya, B. Chen, S. Chariton, E. Greenberg, V. B. Prakapenka, P. R. Buseck, **S.-H. Shim** [PI]. Effect of nickel on the high-pressure phases in Fe–H. Physical Review B, DOI: 10.1103/PhysRevB.104.224106, 2021.

79. **H. Piet** [PD], K. Leinenweber, E. Greenberg, V. B. Prakapenka, and **S.-H. Shim** [PI]. Effects of hydrogen on the phase relations in Fe–FeS at pressures of Mars-sized bodies. Journal of Geophysical Research: Planet, DOI: 10.1029/2021JE006942, 2021.

78. **T. Kim** [vGS], S. Chariton, V. Prakapenka, A. Pakhomova, H.-P. Liermann, Z. Liu, S. Speziale, **S.-H. Shim** [cPI], and Y. Lee. Atomic scale mixing between MgO and H_2O in the deep interiors of water-rich planets. Nature Astronomy, DOI: 10.1038/s41550-021-01368-2, 2021.
Press release: Salon, ASU, Nature Astronomy News and Views .

77. R. J. Husband, R. S. McWilliams, E. J. Pace, A. L. Coleman, H. Hwang, J. Choi, **T. Kim** [vGS], G. Hwang, O. B. Ball, S. H. Chun, D. Nam, S. Kim, H. Cynn, V. B. Prakatenka, **S.-H. Shim**, S. Toleikis, M. I. McMahon, Y. Lee, and H.-P. Liermann. X-ray laser heating of water with gold at high static pressure. Communications Materials, DOI: 10.1038/s43246-021-00158-7, 2021.

76. **T. Kim** [vGS], **B. Ko** [GS], E. Greenberg, V. B. Prakapenka, **S.-H. Shim** [cPI], and Y. Lee. Low melting temperature of anhydrous mantle materials at the core-mantle boundary. Geophysical Research Letters, DOI: 10.1029/2020GL089345, 2020.

75. **H. Chen** [GS], S.-Y. Xie, **B. Ko** [GS], **T. Kim** [vGS], **C. Nisr** [PD], V. B. Prakapenka, E. Greenberg, D. Zhang, W. Bi, E. Alp, Y. Lee, and **S.-H. Shim** [PI]. A new iron hydroxide phase stable in hydrous lower-mantle systems. Earth and Planetary Science Letters, DOI: 10.1016/j.epsl.2020.116551, 2020.

74. **H. Horn** [GS], E. Garhart, K. Leinenweber, V. B. Prakapenka, E. Greenburg, and **S.-H. Shim** [PI]. Oxidation of the interiors of carbide exoplanets. Planetary Science Journal, DOI: 10.3847/PSJ/abaa3e, 2020.
Press release: CNN, Pre-print is available at arXiv:2005.03175.

73. **C. Nisr** [PD], **H. Chen** [GS], K. Leinenweber, A. V. G. Chizmeshya, V. B. Prakapenka, C. Prescher, S. Tkachev, Y. Meng, Z. Liu, and **S.-H. Shim** [PI]. Large H_2O solubility in dense silica and its implications for the interiors of water-rich planets. Proceedings of the National Academy of Sciences, DOI: 10.1073/pnas.1917448117, 2020.
Press release: Selected for Media Highlight by PNAS, ASU Now, Advanced Photon Source Science Highlights, Phys.org, Argonne National Laboratory Press Release

72. J.-A. Hernandez, G. Morard, M. Guarguaglini, R. Alonso-Mori, A. Benuzzi-Mounaix, R. Bolis, G. Fiquet, E. Galtier, A. E. Gleason, S. Glenzer, F. Guyot, **B. Ko** [GS], H. J. Lee, W. L. Mao, B. Nagler, N. Ozaki, A. K. Schuster, **S.-H. Shim**, T. Vinci, and A. Ravasio. Direct observation of shock-induced amorphization of enstatite. Geophysical Research Letters, DOI: 10.1073/pnas.1920470117, 2020.

71. C. M. Lisse, S. J. Desch, C. T. Unterborn, S. R. Kane, P. R. Young, H. E. Hartnett, N. R. Hinkel, **S.-H. Shim**, E. E. Mamajek, and N. R. Izenberg. A geologically robust procedure for observing rocky exoplanets to maximize the likelihood that atmospheric oxygen is an Earth-Like biosignature. Astrophysical Journal Letters, DOI: 10.3847/2041-8213/ab9b91, 2020.

70. H. Li, Y. Qin, **B. Ko** [GS], D. B. Trivedi, Y. M. Sayad, L. Liu, **S.-H. Shim**, H. Zhuang, and S. Tongay. Anomalous behavior of 2D Janus monolayers under extreme pressures. Advanced Materials, DOI: 10.1002/adma.202002401, 2020.

69. G. Morard, J.-A. Hernandez, M. Guarguaglini, R. Bolis, A. Benuzzi-Mounaix, T. Vinci, G. Fiquet, M. A. Baron, **S.-H. Shim** [cPI], **B. Ko** [GS], A. E. Gleason, W. L. Mao, R. Alonso-Mori, H. J. Lee, B. Nagler, E. Galtier, D. Sokaras, S. Glenzer, D. Andrault, G. Garbarino, M. Mezouar, A. Schuster, and A. Ravasio. In situ X-ray diffraction of silicate liquids and glasses under dynamic and static compression to megabar pressures. Proceedings of the National Academy of Sciences, DOI: 10.1073/pnas.1920470117, 2020.

68. H. Hwang, E. Galtier, H. Cynn, I. Eom, S. H. Chun, Y. Bang, G. C. Hwang, J. Choi, **T. Kim** [vGS], M. Kong, S. Kwon, K. Kang, H. J. Lee, C. Park, J.-I. Lee, Y. Lee, W. Yang, **S.-H. Shim**, T. Vogt, S. Kim, J. Park, S. Kim, D. Nam, J. H. Lee, H. Hyun, M. Kim, T.-Y. Koo, C.-C. Kao, T. Sekine, and Y. Lee. Sub-nanosecond phase transition dynamics in laser-shocked iron. Science Advances, DOI: 10.1126/sciadv.aaz5132, 2020.

67. **H. Piet** [PD], K. Leinenweber, **J. Tappan** [UG], E. Greenberg, V. B. Prakapenka, P. R. Buseck, and **S.-H. Shim** [PI]. Dehydration of δ-AlOOH in Earth's deep lower mantle: Implications for the deep hydrogen and oxygen cycles. Minerals, 10, 384, DOI: 10.3390/min10040384, 2020.

66. **H. Chen** [GS], K. Leinenweber, V. B. Prakapenka, M. Kunz, H. Bechtel, Z. Liu, and **S.-H. Shim** [PI]. Phase transformation of hydrous ringwoodite to the lower-mantle phases and the formation of dense hydrous silica. American Mineralogist, DOI: 10.2138/am-2020-7261, 2020.

65. **B. Ko** [GS], V. B. Prakapenka, M. Kunz, C. Prescher, K. Leinenweber, and **S.-H. Shim** [PI]. Mineralogy and density of Archean volcanic crust in the mantle transition zone. Physics of the Earth and Planetary Interiors, DOI: 10.1016/j.pepi.2020.106490, 2020.

64. L. Bindi, **S.-H. Shim**, T. Sharp, and X. Xie. Evidence for the charge disproportionation of iron in extraterrestrial bridgmanite. Science Advances, 6, eaay7893, DOI: 10.1126/sciadv.aay7893, 2020.
Press release: National Science Foundation Research News, ASU Now

63. **B. L. Kulka** [UG], **J. Dolinschi** [UG], K. Leinenweber, V. B. Prakapenka, and **S.-H. Shim** [PI]. The bridgmanite–akimotoite–majorite triple point determined in large volume press and laser-heated diamond anvil cell. Minerals, 10, 67, DOI: 10.3390/min10010067, 2020.

62. **H. Chen** [GS], K. Leinenweber, V. B. Prakapenka, C. Prescher, Y. Meng, H. Bechtel, M. Kunz, and **S.-H. Shim** [PI]. Possible H_2O storage in the crystal structure of $CaSiO_3$ perovskite. Physics of the Earth and Planetary Interiors, 299, 106412, DOI: 10.1016/j.pepi.2019.106412, 2019.
Press release: Advanced Light Source Science Briefs

61. **J. G. O'Rourke** [PD] and **S.-H. Shim**. Hydrogenation of the Martian core by hydrated mantle minerals with implications for the early dynamo. Journal of Geophysical Research: Planets, 124, 3422–3441, DOI: 10.1029/2019JE005950, 2019.

60. **H. Chen** [GS], S. Zhou, D. Morgan, V. B. Prakapenka, E. Greenberg, K. Leinenweber, and **S.-H. Shim** [PI]. The O–O bonding and hydrogen storage in the pyrite-type PtO_2. Inorganic chemistry, 58, 8300–8307, DOI: 10.1021/acs.inorgchem.9b00046, 2019.

59. **Y. Ye** [PD], **S.-H. Shim** [PI], V. B. Prakapenka, and Y. Meng. Equation of state of solid Ne inter-calibrated with the MgO, Au, Pt, NaCl-B2, and ruby pressure scales up to 130 GPa. High Pressure Research, 38, 377–395, DOI: 10.1080/08957959.2018.1493477, 2018.

58. **H. Chen** [GS], **S.-H. Shim** [PI], K. Leinenweber, V. B. Prakapenka, Y. Meng, and C. Prescher. Crystal Structure of $CaSiO_3$ perovskite at 28–62 GPa and 300 K under quasi-hydrostatic stress conditions. American Mineralogist, 103, 462–468, DOI: 10.2138/am-2018-6087, 2018.

57. **C. Nisr** [PD], **S.-H. Shim** [PI], and K. Leinenweber. Raman spectroscopy of water-rich stishovite and dense high-pressure silica up to 55 GPa. American Mineralogist, 102, 2180–2189, DOI: 10.2138/am-2017-5944, 2017.

56. **S.-H. Shim** [PI], **B. Grocholski** [PD], **Y. Ye** [PD], E. Alp, S. Xu, D. Morgan, Y. Meng, and V. B. Prakapenka. Stability of ferrous-iron-rich bridgmanite under reducing mid-mantle conditions. Proceedings of the National Academy of Sciences, 114, 6468–6473, DOI: 10.1073/pnas.1614036114, 2017.
Press release: Advanced Photon Source Science Highlights

55. **C. Nisr** [PD], K. Leinenweber, V. B. Prakapenka, C. Prescher, S. Tkachev, and **S.-H. Shim** [PI]. Phase transition and equation of state of dense hydrous silica up to 63 GPa. Journal of Geophysical Research: Solid Earth, 122, 6972–6983, DOI: 10.1002/2017JB014055, 2017.

54. **Y. Ye** [PD], V. B. Prakapenka, Y. Meng, and **S.-H. Shim** [PI]. Inter-comparison of the gold, platinum, and MgO pressure scales up to 140 GPa and 2,500 K. Journal of Geophysical Research: Solid Earth, 122, 3450–3464, DOI: 10.1002/2016JB013811, 2017.

53. **C. Nisr** [PD], Y. Meng, A. MacDowell, J. Yan, V. B. Prakapenka, and **S.-H. Shim** [PI]. Thermal expansion of SiC at high pressure–temperature and implications for thermal convection in the deep interiors of carbide exoplanets. Journal of Geophysical Research: Planets, 122, 124–133, DOI: 10.1002/2016JE005158, 2017.
Press release: EOS Research Spotlights

52. E. J. Garnero, A. K. McNamara, and **S.-H. Shim**. Continent-sized anomalous zones with low seismic velocity at the base of Earth's mantle. Nature Geoscience, 9, 481–489, DOI: 10.1038/ngeo2733, 2016.

51. H. Piet, J. Badro, F. Nabiei, T. Dennenwaldt, **S.-H. Shim**, M. Cantoni, C. Hébert, and Philippe Gillet. Spin and valence dependence of iron partitioning in Earth's deep mantle. Proceedings of the National Academy of Sciences, 113, 11127–11130, DOI: 10.1073/pnas.1605290113, 2016.

50. K. Vilella, **S.-H. Shim**, C. G. Farnetani, and J. Badro. Spin state transition and partitioning of iron: effects on mantle dynamics. Earth and Planetary Science Letters, 417, 57–66, DOI: 10.1016/j.epsl.2015.02.009, 2015.

49. M. Pagano, A. Truitt, P. A. Young, and **S.-H. Shim**. The chemical composition of τ Ceti and possible effects on terrestrial planets. Astrophysical Journal, 803, 90, DOI: 10.1088/0004-637X/803/2/90, 2015.

48. S. Xu, **S.-H Shim**, and D. Morgan. Origin of Fe^{3+} in Fe-containing, Al-free mantle silicate perovskite. Earth Planetary Science Letters, 409, 319–328, DOI: 10.1016/j.epsl.2014.11.006, 2015.

47. **Y. Ye** [PD], **C. Gu** [GS], **S.-H. Shim** [PI], Y. Meng, and V. B. Prakapenka. The postspinel boundary in pyrolitic compositions determined in the laser-heated diamond anvil cell. Geophysical Research Letters, 41, 3833–3841, DOI: 10.1002/2014GL060060, 2014.

46. X. Shang, **S.-H. Shim**, M. V. de Hoop, and R. D. van der Hilst. Multiple seismic reflectors in Earth's lowermost mantle. Proceedings of the National Academy of Sciences, 111, 2442–2446, DOI: 10.1073/pnas.1312647111, 2014.

45. P. A. Young, S. J. Desch, A. D. Anbar, R. Barnes, N. R. Hinkel, R. Kopparapu, N. Madhusudhan, N. Monga, M. D. Pagano, M. A. Riner, E. Scannapieco, **S.-H. Shim**, and A. Truitt. Astrobiological stoichiometry. Astrobiology, 14, 603–626, DOI: 10.1089/ast.2014.1143, 2014.

44. **B. Grocholski** [PD], **S.-H. Shim** [PI], E. Cottrell, and V. B. Prakapenka. Crystal structure and compressibility of lead dioxide up to 140 GPa. American Mineralogist, 99, 170–177, DOI: 10.2138/am.2014.4596, 2014.

43. **B. Grocholski** [PD], **S.-H. Shim** [PI], and V. B. Prakapenka. Stability, metastability, and elastic properties of a dense silica polymorph, seifertite. Journal of Geophysical Research: Solid Earth, 118, B50360, DOI: 10.1002/jgrb.50360, 2013.

42. **C. Gu** [GS], **K. Catalli** [GS], **B. Grocholski** [PD], L. Gao, E. Alp, P. Chow, Y. Xiao, H. Cynn, W. J. Evans, and **S.-H. Shim** [PI]. Electronic structure of iron in magnesium silicate glasses at high pressure. Geophysical Research Letters, 39, L24304, DOI: 10.1029/2012GL053950, 2012.

41. **B. Grocholski** [PD], **K. Catalli** [GS], **S.-H. Shim** [PI], and V. B. Prakapenka. Mineralogical effects on the detectability of the post-perovskite boundary. Proceedings of the National Academy of Sciences, 109, 2275–2279, DOI: 10.1073/pnas.1109204109, 2012.

40. **K. Catalli** [GS], **S.-H. Shim** [PI], P. Dera, V. B. Prakapenka, J. Zhao, W. Sturhahn, Y. Xiao, P. Chow, H. Cynn, and W. Evans. Effects of the Fe^{3+} spin transition on the properties of aluminous perovskite – New insights for lower-mantle seismic heterogeneities. Earth and Planetary Science Letters, 310, 293–302, DOI: 10.1016/j.epsl.2011.08.018, 2011.

39. **S.-H. Shim** [PI], **D. LaBounty** [UG], and T. S. Duffy. Raman spectra of bixbyite, Mn_2O_3, up to 40 GPa. Physics and Chemistry of Minerals, 38, 685–691, DOI: 10.1007/s00269-011-0441-4, 2011.

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37. **B. Grocholski** [PD], **S.-H. Shim** [PI], and V. B. Prakapenka. Stability of the $MgSiO_3$ analog $NaMgF_3$ and its implication for mantle structure in super-Earths. Geophysical Research Letters, 37, L14204, DOI: 10.1029/2010GL043645, 2010.

36. **K. Catalli** [GS], **S.-H. Shim** [PI], V. B. Prakapenka, J. Zhao, W. Sturhahn, P. Chow, Y. Xiao, H. Liu, H. Cynn, and W. J. Evans. Spin state of ferric iron in $MgSiO_3$ perovskite and its effect on elastic properties. Earth and Planetary Science Letters, 289, 68–75, DOI: 10.1016/j.epsl.2009.10.029, 2010.

35. Q. Cao, P. Wang, R. D. van der Hilst, M. V. de Hoop, and **S.-H. Shim**. Imaging the upper mantle transition zone with a generalized Radon transform of *SS* precursors. Physics of the Earth and Planetary Interiors, 180, 80–91, DOI: 10.1016/j.pepi.2010.02.006, 2010.

34. **K. Catalli** [GS], **S.-H. Shim** [PI], V. B. Prakapenka, J. Zhao, and W. Sturhahn. X-ray diffraction and Mössbauer spectroscopy of Fe^{3+}-bearing Mg-silicate post-perovskite at 128–138 GPa. American Mineralogist, 95, 418–421, DOI: 10.2138/am.2010.3352, 2010.

33. R. F. Cooper, R. L. A. Everman, **J. Hustoft** [PD], and **S.-H. Shim**. Mechanism and kinetics of reduction of a FeO–Fe_2O_3–CaO–MgO aluminosilicate melt in a high-CO activity environment. American Mineralogist, 95, 810–824, DOI: 10.2138/am.2010.3375, 2010.

32. **K. Catalli** [GS], **S.-H. Shim** [PI], and V. B. Prakapenka. Thickness and Clapeyron slope of the post-perovskite boundary. Nature, 462, 782–785, DOI: 10.1038/nature08598, 2009.

31. **B. Grocholski** [PD], **S.-H. Shim** [PI], W. Sturhahn, J. Zhao, Y. Xiao, and P. C. Chow. Spin and valence states of iron in $(Mg_{0.8}Fe_{0.2})SiO_3$ perovskite. Geophysical Research Letters, 36, L24303, DOI: 10.1029/2009GL041262, 2009.

30. **S.-H. Shim**[PI] and **K. Catalli**[GS]. Compositional dependence of structural transition pressures in amorphous phases with mantle-related compositions. Earth and Planetary Science Letters, 283, 174–180, DOI: 10.1016/j.epsl.2009.04.018, 2009.

29. **S.-H. Shim**[PI], A. Bengtson, D. Morgan, W. Sturhahn, **K. Catalli**[GS], J. Zhao, M. Lerche, and V. B. Prakapenka. Electronic and magnetic structures of the postperovskite-type Fe_2O_3 and implications for planetary magnetic records and deep interiors. Proceedings of the National Academy of Sciences, 106, 5508–5512, DOI: 10.1073/pnas.0808549106, 2009.

28. **R. Zucker**[UG] and **S.-H. Shim**[PI]. In situ Raman spectroscopy of $MgSiO_3$ enstatite up to 1550 K. American Mineralogist, 94, 1638–1646, DOI: 10.2138/am.2009.3210, 2009.

27. **S.-H. Shim**[PI], **K. Catalli**[GS], **J. Hustoft**[PD], A. Kubo, V. B. Prakapenka, W. A. Caldwell, and M. Kunz. Crystal structure and thermoelastic properties of $(Mg_{0.91}Fe_{0.09})SiO_3$ postperovskite up to 135 GPa and 2700 K. Proceedings of the National Academy of Sciences, 105, 7382–7386, DOI: 10.1073/pnas.0711174105, 2008.

26. **J. Hustoft**[PD], **K. Catalli**[GS], **S.-H. Shim**[PI], A. Kubo, V. B. Prakapenka, and M. Kunz. Equation of state of $NaMgF_3$ postperovskite - implications for the seismic velocity changes in the D″ region. Geophysical Research Letters, 35, L10309, DOI: 10.1029/2008GL034042, 2008.

25. **S. Lundin**[GS], **K. Catalli**[GS], **J. Santillán**[PD], **S.-H. Shim**[PI], V. B. Prakapenka, M. Kunz, and Y. Meng. Effect of Fe on the equation of state of mantle silicate perovskite over 1 Mbar. Physics of the Earth and Planetary Interiors, 168, 97–102, DOI: 10.1016/j.pepi.2008.05.002, 2008.

24. **J. Hustoft**[PD], **S.-H. Shim**[PI], A. Kubo, and N. Nishiyama. Raman spectroscopy of $CaIrO_3$ postperovskite up to 30 GPa. American Mineralogist, 93, 1654–1658, DOI: 10.2138/am.2008.2938, 2008.

23. **K. Catalli**[GS], **S.-H. Shim**[PI], and V. B. Prakapenka. A crystalline-to-crystalline phase transition in $Ca(OH)_2$ at 8 GPa and room temperature. Geophysical Research Letters, 35, L05312, DOI: 10.1029/2007GL033062, 2008.

22. **S.-H. Shim**[PI]. The postperovskite transition. Annual Reviews in Earth and Planetary Sciences, 36, 569–599, DOI: 10.1146/annurev.earth.36.031207.124309, 2008.

21. A. Kubo, B. Kiefer, **S.-H. Shim**, G. Shen, V. B. Prakapenka, R. J. Cava, and T. S. Duffy. Rietveld structure refinement of $MgGeO_3$ post-perovskite phase to 1 Mbar. American Mineralogist, 93, 965–976, DOI: 10.2138/am.2008.2691, 2008.

20. **S. P. Slotznick**[UG] and **S.-H. Shim**[PI]. In situ Raman spectroscopy measurements of $MgAl_2O_4$ spinel up to 1400°C. American Mineralogist, 93, 470–476, DOI: 10.2138/am.2008.2687, 2008.

19. R. D. van der Hilst, M. V. de Hoop, P. Wang, **S.-H. Shim**[cPI], P. Ma, and L. Tenorio. Seismostratigraphy and thermal structure of Earth's core-mantle boundary region. Science, 315, 1813–1817, DOI: 10.1126/science.1137867, 2007.

18. **S.-H. Shim**[PI], A. Kubo, and T. S. Duffy. Raman spectroscopy of perovskite and post-perovskite phases of $MgGeO_3$ to 123 GPa. Earth and Planetary Science Letters, 260, 166–178, DOI: 10.1016/j.epsl.2007.05.027, 2007.

17. **J. Santillán**[PD], **S.-H. Shim**[PI], G. Shen, and V. B. Prakapenka. High-pressure phase transition in Mn_2O_3 - application for the crystal structure and preferred orientation of the $CaIrO_3$ type. Geophysical Research Letters, 33, L15307, DOI: 10.1029/2006GL026423, 2006.

16. **S.-H. Shim** [PI], **S. Rekhi** [PD], M. C. Martin, and R. Jeanloz. Vibrational spectroscopy and X-ray diffraction of $Cd(OH)_2$ to 23 GPa at 300 K. Physical Review B, 74, 024107, DOI: 10.1103/PHYSREVB.74.024107, 2006.

15. **S.-H. Shim**, T. S. Duffy, R. Jeanloz, and G. Shen. Stability and crystal structure of $MgSiO_3$ perovskite to the core-mantle boundary. Geophysical Research Letters, 31, L10603, DOI: 10.1029/2004GL019639, 2004.

14. **S.-H. Shim**, T. S. Duffy, R. Jeanloz, C.-S. Yoo, and V. Iota. Raman spectroscopy and x-ray diffraction of phase transitions in Cr_2O_3 to 61 GPa. Physical Review B, 69, 144107, DOI: 10.1103/PhysRevB.69.144107, 2004.

13. K. K. M. Lee, B. O'Neil, W. R. Panero, **S.-H. Shim**, L. R. Benedetti, and R. Jeanloz. Equations of state of the high-pressure phases of a natural peridotite and implications for the earth's lower mantle. Earth and Planetary Science Letters, 223, 381–393, DOI: 10.1016/j.epsl.2004.04.033, 2004.

12. C. S. Zha, W. A. Bassett, and **S.-H. Shim**. Rhenium, an in situ pressure calibrant for internally heated diamond anvil cells. Reviews of Scientific Instruments, 75, 2409–2418, DOI: 10.1063/1.1765752, 2004.

11. **S.-H. Shim**, R. Jeanloz, and T. S. Duffy. Tetragonal structure of $CaSiO_3$ perovskite above 20 GPa. Geophysical Research Letters, 29, 2166, DOI: 10.1029/2002GL016148, 2002.

10. **S.-H. Shim**, T. S. Duffy, and K. Takemura. Equation of state of gold and its application to the phase boundaries near the 660-km depth in the mantle. Earth and Planetary Science Letters, 203, 729–739, DOI: 10.1016/S0012-821X(02)00917-2, 2002.

9. **S.-H. Shim** and T. S. Duffy. Raman spectra of Fe_2O_3 to 62 GPa: Implications for thermodynamics and phase transformation. American Mineralogist, 87, 318–326, DOI: 10.2138/am-2002-2-314, 2002.

8. **S.-H. Shim**, T. S. Duffy, and G. Shen. Stability and structure of $MgSiO_3$ perovskite to 2300-km depth conditions. Science, 293, 2437–2440, DOI: 10.1126/science.1061235, 2001.

7. **S.-H. Shim**, T. S. Duffy, and G. Shen. The post-spinel transformation in Mg_2SiO_4 and its relation to the 660-km seismic discontinuity. Nature, 411, 571–574, DOI: 10.1038/35079053, 2001.

6. **S.-H. Shim**, T. S. Duffy, and G. Shen. The stability and P–V–T equation of state for $CaSiO_3$ perovskite in the earth's lower mantle. Journal of Geophysical Research: Solid Earth, 105, 25955–25968, DOI: 10.1029/2000JB900183, 2000.

5. **S.-H. Shim**, T. S. Duffy, and G. Shen. The equation of state of $CaSiO_3$ perovskite to 108 GPa at 300 K. Physics of the Earth and Planetary Interiors, 120, 327–338, DOI: 10.1016/S0031-9201(00)00154-0, 2000.

4. **S.-H. Shim** and T. S. Duffy. Constraints on the P–V–T equation of state of $MgSiO_3$ perovskite. American Mineralogist, 85, 354–363, DOI: 10.2138/am-2000-2-314, 2000.

3. **S.-H. Shim**, A. Navrotsky, T. R. Gaffney, and J. E. MacDougall. Chabazite: energetics of hydration, enthalpy of formation, and effect of cations on stability. American Mineralogist, 84, 1870–1882, DOI: 10.2138/am-1999-11-1214, 1999.

2. **S.-H. Shim**, S. J. Kim, and J. H. Ahn. Quantitative analysis of alkali feldspar minerals using Rietveld refinement of X-ray diffraction data. American Mineralogist, 81, 1133–1140, DOI: 10.2138/am-1996-9-1011, 1996.

1. **S.-H. Shim**, J. H. Ahn, and S. J. Kim. Quantitative analysis of feldspar mixture samples using the Rietveld refinement method. Journal of the Mineralogical Society of Korea, 7, 62–79, 1994.

Peer-Reviewed Book Chapters

1. **S.-H. Shim**. Stability of $MgSiO_3$ perovskite in the lower mantle. In Earth's Deep Mantle: Structure, Composition, and Evolution, edited by R. D. van der Hilst, J. Bass, J. Matas, and J. Trampert, volume 160 of Geophysical Monograph Series, 261–282. American Geophysical Union, 2005.

Non-Peer-Reviewed Articles

2. **S.-H. Shim** and T. Lay. Deep Earth: Post-perovskite at ten. Nature Geoscience, 7, 621–623, 2014.

1. T. Lay, D. Heinz, M. Ishii, **S.-H. Shim**, J. Tsuchiya, T. Tsuchiya, R. Wentzcovitch, and D. Yuen. Multidisciplinary impact of the deep mantle phase transition in perovskite structure. Eos Transactions, 86, 1–4, 2005.

Apps, Jupyter Notebooks, and Codes

Only the software and the codes with DOI are listed below. More software and codes can be found in Shim's GitHub repository. All the software and codes developed by Shim are open source.

8. **X. Wei** [GS] and **S.-H. Shim**. IXE – X-ray emission spectroscopy analysis. Zenodo. DOI: 10.5281/zenodo.18346803, Github Repo, 2026.

7. **S.-H. Shim**. Caker - A python application for batch processing diffraction images. Zenodo. DOI: 10.5281/zenodo.15015748, Github Repo, 2025.

6. **S.-H. Shim**. Calculator for H in FeH_x. Zenodo. DOI: 10.5281/zenodo.7662676, Github Repo, 2023.

5. **S.-H. Shim**. Inverse Birch-Murnaghan equation with spline interpolation. Zenodo. DOI: 10.5281/zenodo.6349563, Github Repo, 2022.

4. **S.-H. Shim**. Unit cell fitting in Jupyter. Zenodo. DOI: 10.5281/zenodo.6344949, Github Repo, 2022.

3. **S.-H. Shim**. JCPDSTools - A python app for creating, converting, and revising high-pressure diffraction information file. Zenodo. DOI: 10.5281/zenodo.6349449, Github Repo, 2022.

2. **S.-H. Shim**. PeakPo - A python software for X-ray diffraction analysis at high pressure and high temperature. Zenodo. DOI: 10.5281/zenodo.810199, Github Repo, 2017.

1. **S.-H. Shim**. Pytheos - a python tool set for equations of state. Zenodo. DOI: 10.5281/zenodo.802392, Github Repo, 2017.

Presentations

Tags: Shim's recent developments are highlighted with the following symbols.

Solar-system planets and exoplanets Technical developments Educational developments

Colloquia and Lectures

2025: Interdisciplinary Course "Warm Dense Matter: Concepts and Fundamentals", virtual, Lawrence-Livermore National Laboratory

2025: Korea Basic Science Institute, Daejeon, South Korea

2025: High Pressure Geoscience Youth Forum in China, virtual

2024: Department of Earth and Environmental Sciences, University of Rochester, Rochester, NY

2023: Astrobiology Program, University of Washington, Seattle, WA

2023: Department of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI

2023: Department of Geosciences, Princeton University, Princeton, NJ

2023: Ice Giant Systems Seminar Series, Applied Physics Laboratory, Johns Hopkins University, Webinar
Video on YouTube,

2023: Department of Earth and Planetary Sciences, Stanford University, Stanford, CA

2023: High Energy Density Science Center, Livermore National Laboratory, Livermore, CA

2022: Advanced Photon Source High Pressure Special Interest Group Meeting, virtual

2020: Seismology Seminar, Seismology Laboratory, University of California, Berkeley, CA

2020: School of Earth and Space Exploration, Arizona State University, Tempe, AZ

2019: Department of Earth System Science, Yonsei University, Seoul, Korea

2019: School of Earth and Environmental Science, Seoul National University, Seoul, Korea

2018: China University of Geosciences, Wuhan, China

2018: School of Earth and Environmental Science, Seoul National University, Seoul, Korea

2018: Department of Earth System Sciences, Yonsei University, Seoul, Korea

2018: Equation of state, Cooperative Institute for Dynamic Earth Research (CIDER)–Kavli Institute for Theoretical Physics (KITP) Program: Relating Geophysical and Geochemical Heterogeneity in the Deep Earth, Santa Barbara, CA

2017: Mars InSight Mission team, Jet Propulsion Laboratory, CA

2017: Seismological Laboratory, California Institute of Technology, Pasadena, CA

2016: Public lecture on planetary interiors, KAOS foundation, Seoul, Korea

2016: School of Earth and Environmental Sciences, Seoul National University, Seoul, Korea

2016: Korea Basic Science Institute (KBSI), Chungju, Korea

2016: Lecture, Cooperative Institute for Dynamic Earth Research (CIDER), 2016 Summer Program, "Flow in the Deep Earth", Santa Barbara, CA
Video Lecture,

2016: Bavarian Research Institute of Experimental Geochemistry and Geophysics (BGI) University of

Bayreuth, Bayreuth, Germany

2016: Seismology Seminar, Seismology Laboratory, University of California, Berkeley, CA

2014: Department of Geology and Geophysics, University of Utah, Salt Lake City, UT

2014: Umbgrove Lectures, Department of Geosciences, Universiteit Utrecht, Utrecht, Nederland

2014: Institut de Physique du Globe de Paris (IPGP), Paris, France

2013: Center for the Origin, Dynamics and Evolution of Planets (CODEP), University of California, Santa Cruz, CA

2012: Institut de Physique du Globe de Paris (IPGP), Paris, France

2011: School of Environmental Science and Engineering, Pohang University of Science and Technology, Pohang, Korea

2011: School of Earth and Environmental Science, Seoul National University, Seoul, Korea

2011: Korea Astronomy and Space Science Institute, Daejeon, Korea

2011: School of Earth and Space Exploration, Arizona State University, Tempe, AZ

2011: Department of Geology, University of Maryland, College Park, MD

2010: Scripps Institution of Oceanography, University of California, San Diego, CA

2010: Department of Earth and Environmental Sciences, Ludwig-Maximilians University, Munich, Germany

2010: Department of Earth Sciences, Swiss Federal Institute of Technology (ETH), Zurich, Switzerland

2010: School of Earth and Environmental Science, Seoul National University, Seoul, Korea

2010: Department of Earth System Sciences, Yonsei University, Seoul, Korea

2009: Geophysics Colloquium, Princeton University, Princeton, NJ

2008: Department of Physics, University of Toronto, Toronto, Canada

2007: Department of Geological Sciences, Brown University, Providence, RI

2007: School of Earth and Environmental Science, Seoul National University, Seoul, Korea

2007: Department of Earth System Sciences, Yonsei University, Seoul, Korea

2007: Department of Earth and Environment Sciences, Chungbuk National University, Chungjoo, Korea

2006: Department of Earth and Atmospheric Sciences, Cornell University, Ithaca, NY

2006: Department of Earth and Environmental Sciences, Rensselaer Polytechnic Institute, Troy, NY

2004: Cooperative Institute for Deep Earth Research (CIDER) Summer Workshop, Kavli Institute for Theoretical Physics, University of California, Santa Barbara, CA

2004: Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA

2002: School of Earth and Environmental Science, Seoul National University, Seoul, Korea

2002: Seismological Laboratory, University of California, Berkeley, CA

2002: Seismological Laboratory, California Institute of Technology, Pasadena, CA

2001: Department of Geology and Geophysics, Yale University, New Haven, CT

2001: Department of Geology, University of Illinois, Champaign, IL

2001: Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA

Invited Talks at Workshops

2026: Geological Society of Korea Planetary Science Short Course Season 5, "How to Study a Planet"

2022: Stanford Synchrotron Radiation Lightsource (SSRL) / Linac Coherent Light Source (LCLS) Users' Meeting and Workshops, Menlo Park, CA

2021: 10th Asian Conference on High Pressure Research, Virtual

2021: Advances in synchrotron-based research towards understanding the structure, evolution, and dynamics of Earth and planetary interiors, co-organized by Geoscience Synchrotron Users Group, GeoSoilEnviroCARS, and COMPRES, Virtual
Video on YouTube,

2019: Inelastic X-ray and Nuclear Resonant Scattering and Applications in Earth Sciences, Consortium for Materials Properties Research in Earth Sciences (COMPRES) Annual Meeting, Montana

2018: Stanford Synchrotron Radiation Lightsource (SSRL) / Linac Coherent Light Source (LCLS) Users' Meeting and Workshops, Menlo Park, CA

2018: Synchrotron Infrared Spectroscopy on Materials in Extreme, National Synchrotron Light Source (NSLS)-II and Center for Functional Nanomaterials (CFN) Users' Meeting, Brookhaven, NY

2018: Advanced Photon Source / Center for Nanoscale Materials Users Meeting, Argonne, IL

2017: 5th High power laser workshop, SLAC National Accelerator Laboratory, Menlo Park, CA

2016: Deutsches Elektronen-Synchrotron – Arizona State University workshop, Hamburg, Germany

2016: Institute for Study of the Earth's Interior (ISEI) Misasa VI Symposium, Okayama University, Japan

2015: Carbon at Extreme Conditions, Centre Européen de Calcul Atomique et Moléculaire (CECAM), CECAM-ETHZ, Lugano, Switzerland

2014: PURE-4 Meeting (IPGP–UCL), Paris, France

2014: PPv@10: A Meeting for the 10th Anniversary of the Discovery of Post-Perovskite, University of Bristol, Bristol, UK

2014: Deep Earth Processes: Windows on the Working of a Planet, London, UK

2013: Interior of the Earth, Gordon Research Conference, South Hadley, MA

2013: Stellar Stoichiometry Workshop, Tempe, AZ

2012: Structure and Dynamics of the Earth's Deep Mantle, Collège de France, Paris, France

2010: Computational Mineral Physics: Applications to Geophysics, Centre Européen de Calcul Atomique et Moléculaire (CECAM), CECAM-ETHZ, Zurich, Switzerland

2009: Interior of the Earth, Gordon Research Conference, South Hadley, MA

2009: Community Workshop, Cooperative Institute for Deep Earth Research, Marshall, CA

2008: Asian Conference in High Pressure Research, Seoul, Korea

2008: High-resolution X-ray Scattering on Earth Materials using Synchrotron Radiation, Advanced Photon Source (APS), Argonne National Laboratory, Argonne, IL

2008: High-Pressure Workshop at the Joint National Synchrotron Light Source (NSLS) and Center for Functional Nanomaterials (CFN) Users Meeting, Brookhaven National Laboratory, Upton, NY

2006: Workshop on Synergy of 21st Century High-Pressure Science and Technology Advanced Photon Source, Argonne National Laboratory, Argonne, IL

2005: Virtual Laboratory for Earth and Planetary Materials (VLab) Workshop, University of Minnesota,

Minneapolis, MN

2004: Consortium for Materials Properties Research in Earth Sciences (COMPRES) Sponsored Workshop, Structure Determination by Single Crystal X-ray Diffraction at Megabar Pressures, Advanced Photon Source, Argonne National Laboratory, Argonne, IL

2004: GeoSoilEnviro Consortium for Advanced Radiation Source (GSECARS) / Consortium for Materials Properties Research in Earth Sciences (COMPRES) High-Pressure Workshop, Future Directions for the Laser-Heated Diamond Anvil Cell at the Advanced Photon Source, Argonne National Laboratory, Argonne, IL

Invited Conference Presentations

24. **S.-H. Shim** [PI]. From a Single Planet to Thousands of Worlds – Geoscience in the Age of Exoplanets. Geological Society of Korea, Fall Meeting, 2025, Jeju, South Korea.
23. **S.-H. Shim** [PI]. Crucial Role of Materials Chemistry in Deciphering Exoplanet Composition, Structure, and Dynamics. Exoplanets in Our Backyard 2024, Louisville, KY.
22. **S.-H. Shim** [PI]. High-Pressure Chemistry of Hydrogen and Water: Unveiling Implications for Mars, Earth, and Super-Earths. Gordon Research Conference – Research at High Pressure 2024, Holderness, NH.
21. **S.-H. Shim** [PI]. High-Pressure Chemistry Linking Dry and Wet Planets. Abstract EE03.00001, 23rd Biennial Conference of the APS Topical Group on Shock Compression of Condensed Matter (SCCM23) Meeting 2023, Chicago, IL.
20. **S.-H. Shim** [PI]. Hydrogen may play a key role for the fine-scale structures at the Earth's core-mantle boundary. International Union of Crystallography (IUCr) Meeting 2022, Chicago, IL.
19. **S.-H. Shim** [PI], **C. Nisr** [PD], **H. Piet** [PD], **H. Chen** [GS], **B. Ko** [GS], **T. Kim** [vGS], **H. Horn** [GS], S. Charison, V. Prakapenka, M. Kunz, Z. Liu, Y. Lee, A. Chizmeshya, J. O'Rourke, B. Chen, and S. Speziale. Hydrogen in the deep mantle Abstract 10059, Goldschmidt Meeting 2022, Honolulu, HI.
18. **S.-H. Shim** [PI], **H. Piet** [PD], **S. Fu** [PD], **B. Ko** [GS], **T. Kim** [vGS], Y. Lee, V. B. Prakapenka, and S. Chariton. Impacts of hydrogen on the chemistry and structure of rocky planets' cores. Abstract DI23A-01, Fall American Geophysical Union (AGU) Meeting 2021, New Orleans, LA.
17. **S.-H. Shim** [PI], **H. Piet** [PD], **H. Horn** [GS] and **B. Kulka** [GS]. Hydrogen-mineral reactions at high temperatures and high pressures. Abstract MR025-07, Fall American Geophysical Union (AGU) Meeting 2020, San Francisco, CA.
16. **S.-H. Shim** [PI] and **J. Dolinschi** [GS]. Exploring Earth and planets with large databases. Abstract ED044-0002, Fall American Geophysical Union (AGU) Meeting 2020, San Francisco, CA.
15. **S.-H. Shim** [PI], **B. Grocholski** [PD], **Y. Ye** [PD], E. E. Alp, Y. Meng, V. B. Prakapenka, D. Morgan, and S. Xu. Origin of the lower-mantle heterogeneities - importance of the crystal chemistry of bridgmanite. Abstract MR44A–02, Fall American Geophysical Union (AGU) Meeting 2017, New Orleans, LA.
14. **S.-H. Shim** [PI], **C. Nisr** [PD], M. Pagano, **H. Chen** [GS], **B. Ko** [GS], **S. Noble** [UG], K. Leinenweber, P. Young, and S. Desch. Un-Earth-like interiors of the Earth-like planets. Abstract DI52B–01, Fall American Geophysical Union (AGU) Meeting 2015, San Francisco, CA.

13. **S.-H. Shim** [PI], **Y. Ye** [PD], **B. Grocholski** [PD], S. Xu, D. Morgan, J. Zhao, and E. Alp. The post-perovskite transition and mineralogical changes in the chemically heterogeneous lower mantle. Abstract MR23D–01, Fall American Geophysical Union (AGU) Meeting 2014, San Francisco, CA.

12. **S.-H. Shim**, R. D. van der Hilst, **B. Grocholski** [PD], **K. Catalli** [GS], Q. Cao, and X. Shang. Nature of mantle heterogeneities. Goldschmidt Conference 2011, The Geochemical Society, Prague, Czech Republic.

11. **S.-H. Shim** [PI], **B. Grocholski** [PD], **K. Catalli** [GS], W. Sturhahn, and V. B. Prakapenka. Does the spin transition in mantle silicate perovskite change the seismic properties of the lower mantle? Abstract DI11B–03, Fall American Geophysical Union (AGU) Meeting 2010, San Francisco, CA.

10. **S.-H. Shim** [PI], **B. Grocholski** [PD], **K. Catalli** [GS], W. Sturhahn, and V. B. Prakapenka. Iron in mantle silicate perovskite. Acta Mineralogica-Petrographica, Abstract Series, 6, 20th General Meeting of the International Mineralogical Association (IMA) 2010, Hungary, Budapest.

9. **S.-H. Shim** [PI], **K. Catalli** [GS], and **B. Grocholski** [PD]. Valence and spin states of iron in mantle silicate perovskite and their implications for the chemistry and mineralogy of the lower mantle. Abstract V23B–03, Eos Transactions American Geophysical Union, 91, Western Pacific Geophysics Meeting Supplement, 2010, Taipei, Taiwan.

8. **S.-H. Shim** [PI], **K. Catalli** [GS], **B. Grocholski** [PD], and V. B. Prakapenka. Effect of compositional variation on the post-perovskite transition in the lowermost mantle. Japan Geoscience Union Meeting 2010, Chiba City, Japan.

7. **S.-H. Shim** [PI], **K. Catalli** [GS], and **B. Grocholski** [PD]. Mineralogical processes in the lower mantle and their implications for seismic heterogeneities. Abstract U23D–0066, Eos Transactions American Geophysical Union, 90, Fall Meeting Supplement, 2009, San Francisco, CA.

6. **S.-H. Shim** [PI], **B. Grocholski** [PD], and **K. Catalli** [GS]. Size matters - lessons from the interiors of Earth and Mars. Abstract P14B–02, Eos Transactions American Geophysical Union, 89, Fall Meeting Supplement, 2008, San Francisco, CA.

5. **S.-H. Shim** [PI], **J. Hustoft** [PD], **K. Catalli** [GS], A. Kubo, V. B. Prakapenka, and M. Kunz. Bulk sound speed and Grüneisen parameter of postperovskite and their implications for the D" heterogeneities. The 33rd International Geology Congress 2008, Oslo, Norway.

4. **S.-H. Shim**, T. S. Duffy, R. Jeanloz, and G. Shen. Stability and crystal structure of $MgSiO_3$ perovskite in the Earth's deep mantle. Abstract U34A–01, Eos Transactions American Geophysical Union, 85, Fall Meeting Supplement, 2004, San Francisco, CA.

3. **S.-H. Shim** and R. Jeanloz. Equation of state of $MgSiO_3$ perovskite and the chemical composition of the lower mantle. Abstract S338, Eos Transactions American Geophysical Union, 83, Spring Meeting Supplement, 2002, Washington, DC.

2. **S.-H. Shim**, T. S. Duffy, and G. Shen. The post-spinel phase boundary inMg_2SiO_4 and the 660-km seismic discontinuity. Abstract F889, Eos Transactions American Geophysical Union, 82, Fall Meeting Supplement, 2001, San Francisco, CA.

1. **S.-H. Shim**, T. S. Duffy, and G. Shen. In situ determination of phase boundary between spinel and perovskite+periclase in Mg_2SiO_4 by laser heated diamond anvil cell. Abstract F1207, Eos Transactions American Geophysical Union, 81, Fall Meeting Supplement, 2000, San Francisco, CA.

Contributed Conference Presentations

203. **S.-H. Shim** [PI], **H. Horn** [GS], **T. Kim** [PD], **X. Wei** [PD], A. Vazan, V. Prakapenka, and S. Chariton. Chemical Alteration of Sub-Neptune Atmospheres by Reactions with Molten Silicate Interiors. 11th AAS Topical Conference Series: Exoplanet Atmospheres 2026, Denver, CO, March 16–20, 2026.

202. **T. Kim** [PD], A. Vazan, S. Chariton, V. Prakapenka, Y.-J. Ryu, S. Yang, and **S.-H. Shim** [PI]. Chemical coupling between atmosphere and interior of sub-Neptunes: insights from high-pressure experiments. Abstract 443.23, 247th Meeting of the American Astronomical Society 2026, Phoenix, AZ.

201. Y. Zhang, K. Bali, M. Andronaco, H. Yang, A. Chen, L. Libon, E. Boulard, A. Benuzzi-Mounaix, E. Galtier, R. Caracas, A. E. Gleason, G. Morard, C. Dorn, A. Ravasio, S. Pandolfi, **X. Wei** [PD], D. Zheng, C. Prescher, H. J. Lee, N. Czapla, R. Alonso-Mori, **S.-H. Shim**, and W. L. Mao. Laser-driven shock compression on FeOOH: Implications for Fe-O-H interaction in a magma ocean. Abstract MR12A-01, Fall American Geophysical Union (AGU) Meeting 2025, New Orleans, LA.

200. **A. Pease** [PD], H. Krauss, and **S.-H. Shim** [PI]. An Open-Source Software for Calculating and Comparing Pressure Under Extreme Conditions. Abstract MR12A-09, Fall American Geophysical Union (AGU) Meeting 2025, New Orleans, LA.

199. **S. Chen** [PD], **T. Kim** [PD], M. Bose, S. Chariton, V. Prakapenka, D. Smith, R. Hrubiak, and **S.-H. Shim** [PI]. Hydrogen at the core-mantle boundary of Mars. Abstract DI51A-05, Fall American Geophysical Union (AGU) Meeting 2025, New Orleans, LA.

198. **X. Wei** [GS], **T. Kim** [PD], **S. Chen** [PD], S. Chariton, V. B. Prakapenka, and **S.-H. Shim** [PI]. Equation of State of Mg_2FeH_6 Perovskite: Implications for Hydrogen Ingassing in Sub-Neptune Interiors. Abstract DI51A-04, Fall American Geophysical Union (AGU) Meeting 2025, New Orleans, LA.

197. **A. Campbell** [US], **S. Fu** [PD], L. Shteynman, **S. Chen** [PD], **T. Kim** [PD], and **S.-H. Shim** [PI]. Hydrogen Production and Storage in $CaTiO_3$ Perovskite at Mantle-Related High Pressures. Abstract DI41A-0003, Fall American Geophysical Union (AGU) Meeting 2025, New Orleans, LA.

196. **S. Chen** [PD], **A. M. Pease** [PD], I. Szumila, S. J. Tracy, A. Tipeev, I. Oleynik, and **S.-H. Shim** [PI]. Dynamic Compression of Iron-Sulfur Alloys at the Earth's Core Conditions. Abstract DI33B-0025, Fall American Geophysical Union (AGU) Meeting 2025, New Orleans, LA.

195. J. Zhang, W.-Y. Zhou, M. Hao, W. Su, **T. Kim** [PD], **S. Chen** [PD], **S.-H. Shim**, P. Nguyen, D. Zhang, and K. Armstrong. Elasticity of Fe,Al,Mg,Ti-bearing Davemaoite Explains Lower Mantle Seismic Heterogeneities. Abstract DI22A-03, Fall American Geophysical Union (AGU) Meeting 2025, New Orleans, LA.

194. **T. Kim** [PD], Y. Lee, S. Chariton, V. Prakapenka, E. Greenberg, and **S.-H. Shim** [PI]. Effects of Water on the Post-perovskite Transition. Abstract DI23A-07, Fall American Geophysical Union (AGU) Meeting 2025, New Orleans, LA.

193. **T. Kim** [PD], A. Vazan, S. Chariton, V. Prakapenka, Y. J. Ryu, S. Yang, and **S.-H. Shim** [PI]. Impact of increasing H_2O concentration during conversion of a hydrogen-rich sub-Neptune to a water-rich sub-Neptune. Fall American Geophysical Union (AGU) Meeting 2025, New Orleans, LA.

192. **S.-H. Shim**, H. Horn, T. Kim, X. Wei, and A. Vazan. Hydrogen-magma reactions provide a new mechanism for generating substantial water inventories in sub-Neptune exoplanets. Gordon conference 2025, South Hadley, MA.

191. **S. Chen** [PD], **T. Kim** [PD], **X. Wei** [GS], and **S.-H. Shim** [PI]. Partitioning of Potassium Between FeO and Fe Metal Impacted by Hydrogen and Implications for Earth's Core. Abstract DI13A-3153, Fall American Geophysical Union (AGU) Meeting 2024, Washington, DC.

190. **X. Wei** [GS], **S.-H. Shim** [PI], H. J. Lee, E. Galtier, R. Alonso-Mori, H. Yang, S. Park, W. L. Mao, A. E. Gleason, S. Glenzer, A. Ravasio, S. Pandolfi, G. Morard, and J.-A. Hernandez. Dynamic Compression Study for Fe Spin States in Silicate Melts under Pressure-Temperature Conditions of Super-Earth's Deep Interiors. Abstract DI13B-07, Fall American Geophysical Union (AGU) Meeting 2024, Washington, DC.

189. **T. Kim** [PD], **S.-H. Shim** [PI], S. Chariton, V. Prakapenka, M. Kunz and K. Armstrong. Iron metal formation from silicate melts at 55–75 GPa and 4000–6000 K. Abstract DI31C-2947, Fall American Geophysical Union (AGU) Meeting 2024, Washington, DC.

188. **T. Kim** [PD], **S.-H. Shim** [PI], M. Li, E. Garnero, E. Greenberg, S. Chariton, V. Prakapenka, S. Yang, and Y. Lee. Understanding the ultralow velocity zones at the Earth's core-mantle boundary through synchrotron experiments. Abstract MR21A-07, Fall American Geophysical Union (AGU) Meeting 2024, Washington, DC.

187. T. Sharp, **S.-H. Shim**, K. Leinenweber, D. C. Smith, A. Navrotsky, K. Brugman, S. Chen, K. Tsuno, and L. Leinbach. FORCE (Facility for Open Research in a Compressed Environment) Progress, instrumentation and Initial Experiments. Abstract MR31B-2986, Fall American Geophysical Union (AGU) Meeting 2024, Washington, DC.

186. Y. Zhang, A. Ravasio, H. Yang, S. Pandolfi, A. Chen, L. Libon, E. Boulard, A. E. Gleason, **S.-H. Shim**, G. Morard, and W. L. Mao. Hugoniot Equation of State of FeOOH up to 818 GPa: Insights into Magma Oceans in Exoplanets. Abstract DI11B-3133, Fall American Geophysical Union (AGU) Meeting 2024, Washington, DC.

185. A. J. Chen, H. Yang, Y. Zhang, A. E. Gleason, R. Alonso-Mori, G. Morard, A. Ravasio, **S.-H. Shim**, **X. Wei** [GS], E. Galtier, Y. Han, H. J. Lee, B. Nagler, D. Sokaras, E. Boulard, S. Pandolfi, Q. Hu, J.-A. Hernandez, B. Cui, X. Chen, and W. L. Mao. Probing Atomic and Electronic Structures of Laser-Shock Compressed Hematite (α-Fe_2O_3) to 300 GPa. Abstract DI11B-3148, Fall American Geophysical Union (AGU) Meeting 2024, Washington, DC.

184. **T. Kim** [PD] and **S.-H. Shim** [PI]. High-pressure experiments support compositional gradients in sub-Neptune interiors. Exoplanets in Our Backyard 2024, Louisville, KY.

183. K. Tsuno, D. S. Grewal, V. Xu, L. Leinbach, K. Leinenweber, A. Wittmann, and **S.-H. Shim**. Wetting property of Fe-Ni-N alloy melt in ringwoodite: Implications for nitrogen depletion in the bulk silicate Earth. Goldschmidt Conference 2024, Chicago, IL.

182. **X. Wei** [GS], **S.-H. Shim**, H. J. Lee, E. Galtier, R. Alonso-Mori, H., Yang, W. L. Mao, A. E. Gleason, S. Glenzer, J.-A. Hernandez, A. Ravasio, G. Morard, S. Pandolfi. Spin State Behavior of Iron in Molten Silicates under Dynamic Compression: Implications for Super-Earths. Ultrafast X-Ray Summer School 2024, SLAC National Lab, CA.

181. K. Leinenweber, **S.-H. Shim**, and A. Navrotsky. A Nancy Ross-style description of high-pressure hydrous stishovite ($(Si,H_4)O_2$). Geological Society of America Meeting 2024, Anaheim, CA.

180. **S.-H. Shim** [PI], T. Kim, X. Wei, S. Chariton, V. Prakapenka, Y.-J. Ryu, and S. Yang. Formation of hydride perovskite and water on hot hydrogen-rich exoplanets. Geological Society of America Meeting 2024, Anaheim, CA.

179. **S. Chen**[PD], S. Yang, T. Kim, X. Wei, and **S.-H. Shim**[PI]. Sub-nanometer detection of hydrogen in minerals using vibrational electron energy loss spectroscopy. Geological Society of America Meeting 2024, Anaheim, CA.

178. **X. Wei**[GS], **S.-H. Shim**, H. J. Lee, E. Galtier, R. Alonso-Mori, H. Yang, W. L. Mao, A. E. Gleason, S. Glenzer, J.-A.Hernandez, A. Ravasio, G. Morard, S. Pandolfi. Spin State of Fe in Dynamically Compressed Molten Silicates: Insights into Super-Earths' Deep Interiors. Gordon conference 2024, Holderness, NH.

177. **T. Kim**[PD], **X. Wei**[GS], S. Chariton, V. Prakapenka, Y. J. Ryu, S. Yang, and **S.-H. Shim**[PI]. Formation of Mg-hydrides and water from reaction between MgO and hydrogen and implication for sub-Neptune exoplanets. Abstract DI51A-07, Fall American Geophysical Union (AGU) Meeting 2023, San Francisco, CA.

176. K. J. Agboola, S. Hansen, E. Garnero, M. Li, **S.-H. Shim**, and S. Rost. Ubiquitous ultra-low velocity zone structure beneath the southern hemisphere: evidence from double-array stacking of PcP waveforms. Abstract DI51B-0016, Fall American Geophysical Union (AGU) Meeting 2023, San Francisco, CA.

175. L. Leinbach, K. Brugman, K. Leinenweber, A. Navrotsky, T. G. Sharp, **S.-H. Shim**, D. J. Smith, and K. Tsuno. FORCE (Facility for Open Research in a Compressed Environment) progress and future advances. Abstract MR21B-0049, Fall American Geophysical Union (AGU) Meeting 2023, San Francisco, CA.

174. **H. Horn**[GS], S. Chariton, V. Prakapenka, and **S.-H. Shim**[PI]. Reduction of silicates by hydrogen at high pressure-temperature – Experimental evidence for the formation of hot wet sub-Neptunes. Abstract MR24A-07, Fall American Geophysical Union (AGU) Meeting 2023, San Francisco, CA.

173. **S. Chen**[PD], S. Yang, **T. Kim**[PD], **X. Wei**[GS], and **S.-H. Shim**[PI]. Nondestructive sub-nanometer probe for hydrogen in high-pressure minerals: vibrational electron energy loss spectroscopy. Abstract MR32A-07A, Fall American Geophysical Union (AGU) Meeting 2023, San Francisco, CA.

172. **X. Wei**[GS], S. Chariton, V. Prakapenka, M. Kunz, K. Armstrong, S. Yang, and **S.-H. Shim**[PI]. Effects of H and Si on the solubility of Mg in the metallic iron core, Abstract MR43C-0098, Fall American Geophysical Union (AGU) Meeting 2023, San Francisco, CA.

171. **T. Kim**[PD], S. Chariton, V. Prakapenka, Y. J. Ryu, S. Yang, and **S.-H. Shim**[PI]. Effect of H_2-to-H_2O ratio on the stability of silicates in sub-Neptune exoplanets. Abstract P23F-3106, Fall American Geophysical Union (AGU) Meeting 2023, San Francisco, CA.

170. K. Tsuno, V. Xu, D. S. Grewal, L. Leinbach, K. Leinenweber, A. Wittmann, and **S.-H. Shim**. Wetting property of Fe-Ni-N alloy liquid in ringwoodite – implications for nitrogen depletion in the bulk silicate Earth. Abstract V11C-0076, Fall American Geophysical Union (AGU) Meeting 2023, San Francisco, CA.

169. **H. W. Horn**[GS], V. Prakapenka, S. Chariton, and **S.-H. Shim**[PI]. Reduction of Silicates by Hydrogen at High Pressure-Temperature - Experimental Evidence for the Formation of Hot Wet Sub-Neptunes. Abstract EE03.00002, 23rd Biennial Conference of the APS Topical Group on Shock Compression of Condensed Matter (SCCM23) Meeting 2023, Chicago, IL.

168. **S.-H. Shim**[PI]. Endogenic Water from Hydrogen-Magma Reaction in Sub-Neptunes — Implications for Atmospheric Composition, Internal Structure, and Demographics. Ninth Annual Giant Magellan Telescope Community Science Meeting 2023, Washington, DC.

167. **X. Wei** [GS], V. Prakapenka, S. Chariton, S. Yang, and **S.-H. Shim** [PI]. How Hydrogen Could Facilitate Storage of Magnesium in Iron and Power an Early Dynamo. Gordon conference 2023, Mount Holyoke College, MA.

166. **X. Wei** [GS], S. Chariton, V. Prakapenka, and **S.-H. Shim** [PI]. Phase Relations of Fe-S-H for the Martian Core. International Union of Crystallography (IUCr) Meeting 2022, Chicago, IL.

165. **S. Ravikumar** [US] and **S.-H. Shim** [PI]. A Potential Mechanism for Nitrogen Storage in the Earth's Mantle Transition Zone. International Union of Crystallography (IUCr) Meeting 2022, Chicago, IL.

164. **T. Kim** [PD], E. Greenberg, V. B. Prakapenka, Y. Lee, and **S.-H. Shim** [PI]. Melting behaviors of hydrous pyrolite in the lower mantle. Abstract DI22A-09, Fall American Geophysical Union (AGU) Meeting 2022, Chicago, IL.

163. **B. Ko** [GS], E. Greenberg, V. B. Prakapenka, E. Alp, W. Bi, Y. Meng, D. Zhang, and **S.-H. Shim** [PI]. Dissolution of calcium into bridgmanite and disappearance of davemaoite in warm regions of the lower mantle. Abstract DI26A-02, Fall American Geophysical Union (AGU) Meeting 2022, Chicago, IL.

162. **T. Kim** [PD], J. O'Rourke, J. Lee, S. Chariton, V. Prakapenka, R. Husband, N. Giordano, H.-P. Liermann, Y. Lee, and **S.-H. Shim** [PI]. Possible link between deeply subducted water and the E' layer. Abstract DI36A-05, Fall American Geophysical Union (AGU) Meeting 2022, Chicago, IL.

161. **X. Wei** [GS], S. Chariton, V. Prakapenka, and **S.-H. Shim** [PI]. Effects of Hydrogen on Fe-S Alloy System and their Implications for the Martian Core. Abstract MR35B-0059, Fall American Geophysical Union (AGU) Meeting 2022, Chicago, IL.

160. K. Tsuno, K. Leinenweber, A. Navrotsky, T. Sharp, **S.-H. Shim**, and D. Smith. New High-Pressure Experimental facility in FORCE (Facility for Open Research in a Compressed Environment) and scientific applications. Abstract MR42A-0066, Fall American Geophysical Union (AGU) Meeting 2022, Chicago, IL.

159. S. Hansen, E. Garnero, M. Li, **S.-H. Shim**, and S. Rost. A Global Veneer of Subducted Materials along the Earth's Core-Mantle Boundary. Abstract DI22B-0002, Fall American Geophysical Union (AGU) Meeting 2022, Chicago, IL.

158. K. Leinenweber, A. Navrotsky, D. Smith, T. Sharp, **S.-H. Shim**, K. Tsuno, K. Brugman. FORCE – A Newly Created "Facility for Open Research in a Compressed Environment." Abstract MR45A-03, Fall American Geophysical Union (AGU) Meeting 2022, Chicago, IL.

157. **S.-H. Shim** [PI], **H. Horn** [GS], S. Speziale, S. Chariton, and V. Prakapenka. Chemistry Linking Hydrogen-Rich and Water-Rich Planets. Abstract 3031, Exoplanets in Our Backyard 2, 2022, Albuquerque, NM.

156. **T. Kim** [PD], **X. Wei** [GS], S. Chariton, V. Prakapenka, **S.-H. Shim** [PI]. Impact of the H2/H_2O Ratio on the Internal Structure of Uranus, Neptune, and Sub-Neptune Exoplanets. Abstract 3052, Exoplanets in Our Backyard 2, 2022, Albuquerque, NM.

155. **S.-H. Shim** [PI], **H. Horn** [GS], S. Speziale, S. Chariton, and V. Prakapenka. Hydrogen chemistry for understanding sub-Neptunes. Abstract 404.05, Meeting of the AAS Division for Planetary Sciences 2022, London, Canada.

154. **T. Kim** [PD], Y. Lee, S. Chariton, V. Prakapenka, A. Pakhomova, H.-P. Liermann, Z. Liu, S. Speziale, and **S.-H. Shim** [PI]. Solubility of MgO in H_2O-H_2 at high pressures and its implications for large water-rich planets. Abstract 107.03, Meeting of the AAS Division for Planetary Sciences 2022, London, Canada.

153. **S. Fu** [PD], S. Chariton, V. B. Prakapenka, A. Chizmeshya, and **S.-H. Shim** [PI]. Phase Relations in the Fe-Si-H Ternary up to 125 GPa and 3700 K. Abstract EGU22-3229, European Geophysical Union (EGU) Meeting 2022, Vienna, Austria and Online.

152. **S. Fu** [PD], S. Chariton, V. B. Prakapenka, and **S.-H. Shim** [PI]. Melting Behavior of Fe-Si-H and its Impact on Possible Stratification at the Topmost Outer Core. Goldschmidt Meeting 2022, Honolulu, HI.

151. **H. Horn** [GS], S. Chariton, V. B. Prakapenka, and **S.-H. Shim** [PI]. Chemical interactions between hydrogen-rich envelopes and silicate magma oceans. Abstract MR15A-0045, Fall American Geophysical Union (AGU) Meeting 2021, New Orleans, LA.

150. Q. Yuan, M. Li, E. Garnero, **S.-H. Shim**, and **B. Ko** [GS]. Investigating the dynamics of ultra-high velocity zones above Earth's core-mantle boundary. Abstract DI44B-08, Fall American Geophysical Union (AGU) Meeting 2021, New Orleans, LA.

149. **T. Kim** [vGS], S. Chariton, V. B. Prakapenka, A. Pakhomova, H.-P. Liermann, Z. Liu, S. Speziale, **S.-H. Shim** [PI], and Y. Lee. Atomic-scale mixing between MgO and H_2O in the deep interiors of water-rich planets. Abstract DI32A-06, Fall American Geophysical Union (AGU) Meeting 2021, New Orleans, LA.

148. **S. Fu** [PD], S. Chariton, V. B. Prakapenka, A. Chizmeshya, and **S.-H. Shim** [PI]. Alloys in Fe-Si-H ternary at high pressures-temperatures and their implications for the planetary cores. Abstract DI25C-0047, Fall American Geophysical Union (AGU) Meeting 2021, New Orleans, LA.

147. S. E. Hansen, E. Garnero, S. Rost, M. Li, and **S.-H. Shim**. Ultra-low velocity zone structure at southern latitudes based on *PcP* waveforms and historical interstation pattern referencing. Abstract DI14A-09, Fall American Geophysical Union (AGU) Meeting 2021, New Orleans, LA.

146. **S.-H. Shim** [PI], R. Alonso-Mori, A. Gleason, W. Mao, G. Morard, A. Ravasio, **B. Ko** [GS], **J. Dolinschi** [GS], **J. Tappan** [UG], D. Sokaras, B. Nagler, H. J. Lee, E. Galtier, R. Bolis, J.-A. Hernandez, M. Guarguaglini, A. Benuzzi-Mounaix, T. Vinci, G. Fiquet, and M. Baron. Spin state of iron in dynamically compressed olivine melt. Abstract MR12A-08, Fall American Geophysical Union (AGU) Meeting 2021, New Orleans, LA.

145. **T. Kim** [vGS], J. Lee, S. Chariton, V. B. Prakapenka, R. Husband, N. Giordano, H.-P. Liermann, and **S.-H. Shim** [PI]. Water may limit silicon amount in the Earth's core. Abstract 07-0934, 10th Asian Conference on High Pressure Research 2021.

144. **S.-H. Shim** [PI]. Solubility of magnesium in water at high pressures and its implications for Uranus. Abstract 314.03, Meeting of the AAS Division for Planetary Sciences 2021.

143. **T. Kim** [vGS], S. Chariton, V. Prakapenka, A. Pakhomova, H.-P. Liermann, Z. Liu, S. Speziale, **S.-H. Shim** [PI], and Y. J. Lee Atomic-scale mixing between MgO and H_2O in the deep interiors of water-rich planets. Abstract 495, Europlanet Science Congress 2021, Virtual.

142. **S.-H. Shim**, **C. Nisr** [PD], **T. Kim** [vGS], Y. J. Lee, A. Chizmeshya, K. Leinenweber, S. Chariton, V. Prakapenka, S. Speziale, Z. Liu, and H.-P. Liermann. Mineral-Water Reaction at High Pressures - Implications for Uranus and Neptune. Abstract 1208, Lunar and Planetary Science Conference 2021, Houston, TX.

141. **S. Fu** [PD] and **S.-H. Shim** [PI]. Hydrogen Storage in FeSi Alloy at High Pressure: Implications for the Composition and Structure of Rocky Planets' Cores. Abstract 1735, Lunar and Planetary Science Conference 2021, Houston, TX.

140. **S. Fu** [PD], K. Leinenweber, **S.-H. Shim**. Potential storage of molecular hydrogen in $CaTiO_3$ perovskite in the deep interiors of rocky planets. AASTCS 8: Habitable Worlds, 2021, Virtual.

139. **S.-H. Shim**, **C. Nisr** [PD], **T. Kim** [vGS], Y. Lee, K. Leinenweber, A. Chizmeshya, S. Speziale, V. Prakapenka, C. Prescher, S. Chariton, T. Sergey, Y. Meng, Z. Liu. H_2O-rock reactions at the deep interiors of water-rich planets. AASTCS 8: Habitable Worlds, 2021, Virtual.

138. **B. Kulka** [GS], **T. Kim** [vGS], **J. Lee** [vGS], S. Chariton, V. B. Prakapenka, Y. Lee, and **S.-H. Shim** [PI]. Possible control of redox conditions in the laser-heated diamond-anvil cell. Abstract MR018-0008, Fall American Geophysical Union (AGU) Meeting 2020, San Francisco, CA.

137. **H. Horn** [GS], V. B. Prakapenka, S. Chariton, S. Speziale, and **S.-H. Shim** [PI]. Reduction of iron by hydrogen in early planetary mantles. Abstract DI005-0007, Fall American Geophysical Union (AGU) Meeting 2020, San Francisco, CA.

136. **B. Ko** [GS], S. Chariton, V. B. Prakapenka, B. Chen, S. Yu, E. Garnero, M. Li, and **S.-H. Shim** [PI]. Water-induced diamond formation at the Earth's core-mantle boundary. Abstract DI005-0023, Fall American Geophysical Union (AGU) Meeting 2020, San Francisco, CA.

135. E. Garnero, S. Yu, **S.-H. Shim**, M. Li, **B. Ko** [GS], M. S. Thorne, and C. Zhao. Ultra high velocity zones at the core-mantle boundary. Abstract DI008-05, Fall American Geophysical Union (AGU) Meeting 2020, San Francisco, CA.

134. **H. Horn** [GS] and **S.-H. Shim** [PI]. Effects of water on the mineralogy of carbon-rich exoplanets. Annual Meeting of Consortium for Materials Properties Research in Earth Sciences (COMPRES) 2020.

133. **B. Kulka** [GS] and **S.-H. Shim** [PI]. Toward oxygen fugacity control in laser-heated diamond-anvil cell. Annual Meeting of Consortium for Materials Properties Research in Earth Sciences (COMPRES) 2020.

132. **B. Ko** [GS] and **S.-H. Shim** [PI]. Temperature-dependent solubility of uranium in silicate perovskites in the Earth's lower mantle. Annual Meeting of Consortium for Materials Properties Research in Earth Sciences (COMPRES) 2020.

131. **S.-H. Shim** [PI]. Superstoichiometric alloying of FeNi with H and hydrogen storage in the interiors of giant planets. Abstract 216.01, Meeting of the AAS Division for Planetary Sciences 2020.

130. **J. G. O'Rourke** [PD] and **S.-H. Shim** [PI]. Hydrogenation of the Martian core by hydrated mantle minerals with implications for the early dynamo. Abstract 2475, Lunar and Planetary Science Conference 2020, Houston, TX.

129. **H. Piet** [PD], K. Leinenweber, E. Greenberg, S. Chariton, V. B. Prakapenka, P. R. Buseck, and **S.-H. Shim** [PI]. A potential stratification of the core of Mars caused by hydrogen. Abstract 3025, Exoplanets in our Backyard Meeting 2020, Houston, TX.

128. **S.-H. Shim** [PI], **C. Nisr** [PD], **T. Kim** [vGS], Y. Lee, **H. Chen** [GS], K. Leinenweber, A. V. G. Chizmeshya, S. Speziale, V. B. Prakapenka, C. Prescher, S. Tkachev, Y. Meng, and Z. Liu. Experimental Observations on water-rock interaction at high pressures and their implications for the interiors of Uranus and Neptune. Abstract 3027, Exoplanets in our Backyard Meeting 2020, Houston, TX.

127. **T. Kim** [vGS], **S.-H. Shim** [PI], V. B. Prakapenka, H.-P. Liermann, S. Speziale, Y. Lee. High solubility of Mg in H_2O at high pressures and its implications for the interiors of water-rich planets. Abstract 3031, Exoplanets in our Backyard Meeting 2020, Houston, TX.

126. **H. Horn** [GS], S. Speziale, V. B. Prakapenka, and **S.-H. Shim** [PI]. Interaction between iron/magnesium oxides and hydrogen. Abstract 3036, Exoplanets in our Backyard Meeting 2020, Houston, TX.

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30. A. Kubo, T. S. Duffy, B. Kiefer, **S.-H. Shim**, G. Shen, V. B. Prakapenka, and R. J. Cava. Structure refinement of $MgGeO_3$ post-perovskite phase to 1 Mbar. Abstract MR21B–0025, Eos Transactions American Geophysical Union, 87, Fall Meeting Supplement, 2006, San Francisco, CA.

29. P. Wang, R. B. van der Hilst, M. V. de Hoop, P. Ma, L. Tenorio, and **S.-H. Shim**. 3-D seismic exploration of Earth's deep interior reveals intermittent D″ stratification. Abstract U33B–06, Eos Transactions American Geophysical Union, 87, Fall Meeting Supplement, 2006, San Francisco, CA.

28. **K. Catalli** [GS] and **S.-H. Shim** [PI]. X-ray diffraction and Raman spectroscopy study of $Ca(OH)_2$-portlandite to 26 GPa at 300 K under quasi-hydrostatic conditions. Annual Meeting of Consortium for Materials Properties Research in Earth Sciences (COMPRES) 2006, Snowbird, UT.

27. **S.-H. Shim** [PI], R. Lamm, **S. Rekhi** [PD], **K. Catalli** [GS], **J. Santillán** [PD], and **S. Lundin** [GS]. New micro-Raman spectroscopy systems for high-temperature studies in the diamond anvil cell. Abstract MR13B–02, Eos Transactions American Geophysical Union, 86, Fall Meeting Supplement, 2005, San Francisco, CA.

26. **J. Santillán** [PD] and **S.-H. Shim** [PI]. High pressure phase transition in Mn_2O_3 to the $CaIrO_3$-type phase. Abstract MR23B–0050, Eos Transactions American Geophysical Union, 86, Fall Meeting Supplement, 2005, San Francisco, CA.

25. **S. Lundin** [GS], **S.-H. Shim** [PI], G. Shen, V. B. Prakapenka, H. Liu, and Y. Meng. X-ray diffraction study of ferric calcium silicate perovskite to 62 GPa. Abstract MR23A–0049, Eos Transactions American Geophysical Union, 86, Fall Meeting Supplement, 2005, San Francisco, CA.

24. R. A. Lamm, P. Wang, M. D. Hoop, R. D. van der Hilst, and **S.-H. Shim**. Imaging structure at and near upper mantle discontinuities using a generalized Radon transform. Abstract DI41A–1249, Eos Transactions American Geophysical Union, 86, Fall Meeting Supplement, 2005, San Francisco, CA.

23. T. S. Duffy, A. Kubo, S. R. Shieh, G. Shen, V. B. Prakapenka, B. Kiefer, and **S.-H. Shim**. Compressibility and structural evolution of germanate and silicate post-perovskite phases. Abstract MR22A–07, Eos Transactions American Geophysical Union, 86, Fall Meeting Supplement, 2005, San Francisco, CA.

22. **S. Rekhi** [PD], **S.-H. Shim** [PI], M. Martin, and R. Jeanloz. X-ray diffraction and vibrational spectroscopy studies on brucite-type β-cadmium hydroxide to 36 GPa. Abstract T41B–1180, Eos Transactions American Geophysical Union, 85, Fall Meeting Supplement, 2004, San Francisco, CA.

21. **S.-H. Shim**, T. S. Duffy, R. Jeanloz, and G. Shen. In situ x-ray diffraction study of $MgSiO_3$ perovskite to the core-mantle boundary conditions. Abstract MR21A–02, Eos Transactions American Geophysical Union, 85, Fall Meeting Supplement, 2004, San Francisco, CA.

20. **S.-H. Shim**, K. K. Lee, and R. Jeanloz. Chemical composition of the lower mantle. Study of Matter at Extreme Conditions Conference, 2003, Miami Beach, FL.

19. **S.-H. Shim**, M. R. Frank, Y. Fei, and R. Jeanloz. Comparison of gold and MgO pressure scales at 22–56 GPa and 300-1150 K and its implications for mantle models. Abstract S21E–0364, Eos Transactions American Geophysical Union, 84, Spring Meeting Supplement, 2003.

18. T. S. Duffy and **S.-H. Shim**. Mantle mineralogy and mineral physics: Paradigms and paradoxes. Abstract S12D–02, Eos Transactions American Geophysical Union, 84, Spring Meeting Supplement, 2003.

17. **S.-H. Shim**, R. Jeanloz, and T. S. Duffy. Tetragonal structure of $CaSiO_3$ perovskite at 20–46 GPa. Abstract F616, Eos Transactions American Geophysical Union, 83, Fall Meeting Supplement, 2002.

16. R. Jeanloz, K. K. Lee, and **S.-H. Shim**. Challenging the standard model - equation of state of natural peridotite at lower-mantle conditions. Abstract F626, Eos Transactions American Geophysical Union, 83, Fall Meeting Supplement, 2002.

15. **S.-H. Shim**, T. Kenichi, and T. S. Duffy. New P–V–T equation of state of gold: Application to the post-spinel phase transition and the 660-km seismic discontinuity. Abstract F899, Eos Transactions American Geophysical Union, 82, Spring Meeting Supplement, 2001.

14. T. S. Duffy, **S.-H. Shim**, S. Shieh, and S. Speziale. Experimental studies of crystal structures and elasticity in the deep mantle. Abstract F1108, Eos Transactions American Geophysical Union, 82, Fall Meeting Supplement, 2001.

13. **S.-H. Shim**, T. S. Duffy, and G. Shen. Stability and structure of magnesium silicate perovskite to 2300-km depth in the mantle. The 11th Annual Goldschmidt Conference 2001, The Geochemical Society, Hot Springs, VA.

12. **S.-H. Shim** and T. S. Duffy. Raman spectroscopy of Fe_2O_3 to 62 GPa: implications for phase transformations and thermodynamic properties. Abstract S38, Eos Transactions American Geophysical Union, 81, Spring Meeting Supplement, 2000.

11. **S.-H. Shim** and T. S. Duffy. Structure and magnetic properties of Cr_2O_3 to 61 GPa by Raman spectroscopy and implications for the ruby pressure scale. Abstract S43, Eos Transactions American Geophysical Union, 81, Spring Meeting Supplement, 2000.

10. T. S. Duffy, **S.-H. Shim**, A. Kavner, and G. Shen. Static compression of platinum to 1 Mbar: implications for the pressure-volume-temperature equation of state. Abstract S41, Eos Transactions American Geophysical Union, 81, Spring Meeting Supplement, 2000.

9. T. S. Duffy, A. Kavner, **S.-H. Shim**, and G. Shen. Equation of state and crystal structure of lower mantle and core materials using the laser heated diamond anvil cell. Abstract S49, Eos Transactions American Geophysical Union, 81, Spring Meeting Supplement, 2000.

8. **S.-H. Shim**, T. S. Duffy, and G. Shen. Stability of $MgSiO_3$ to 100 GPa and 2500 K. Abstract F742, Eos Transactions American Geophysical Union, 80, Fall Meeting Supplement, 1999.

7. T. S. Duffy, **S.-H. Shim**, and G. Shen. Stability, structure, and P–V–T equation of state of $CaSiO_3$ perovskites to 110 GPa and 2500 K. Abstract F928, Eos Transactions American Geophysical Union, 80, Fall Meeting Supplement, 1999.

6. A. Wasserman, **S.-H. Shim**, A. Kavner, and T. S. Duffy. Raman spectroscopy of $Ni(OH)_2$ to 22 GPa. Abstract F41, Eos Transactions American Geophysical Union, 80, Fall Meeting Supplement, 1999.

5. **S.-H. Shim**, T. S. Duffy, and G. Shen. P–V–T equation of state of $MgSiO_3$ and $CaSiO_3$ perovskites to 60 GPa and 2000 K. Abstract F861, Eos Transactions American Geophysical Union, 79, Fall Meeting Supplement, 1998.

4. A. Navrotsky, **S.-H. Shim**, T. R. Gaffney, and J. MacDougall. Chabazite: enthalpy of formation and energetics of hydration. International Zeolite Congress, 1998.

3. **S.-H. Shim**, T. S. Duffy, G. Shen, and D. L. Heinz. Phase transition in cobalt above 18 GPa and 1800 K. Abstract S164, Eos Transactions American Geophysical Union, 79, Spring Meeting Supplement, 1998.

2. **S.-H. Shim**, J. H. Ahn, and S. J. Kim. Quantitative analysis of feldspar minerals using Rietveld refinement method. Annual Meeting of the Mineralogical Society of Korea, 1994.

1. J. H. Ahn, **S.-H. Shim**, and S. J. Kim. Quantitative analysis of perthite using Rietveld refinement method. Annual Meeting of the Mineralogical Society of Korea, 1993.

Media Highlights

12. Catalyst: Exploring exoplanets from Earth. Arizona PBS , 2018.

11. Shannon Hall. The labs that forge distant planets here on Earth, High-pressure experiments explore what it might take to make exoplanets habitable. Nature Feature, Nature , 2017.

10. News and Views. S. J. Desch, P. A. Young, A. D. Anbar, N. Hinkel, M. Pagano, A. Truitt, M. Turnbull, Astrobiology, 14, 271–276, 2014.

9. J. Miller. Calculations clarify the role of minerals' electron spins in Earth's mantle. Physics Today 64, 12–13, 2011.

8. APS Science 2010. Electronic and magnetic structures of hematite post-perovskite under deep planetary conditions. 2010.

7. Editors' Highlight. New measurement of electronic spin state of iron in perovskite. Geophysical Research Letters, 2009.

6. K. K. M. Lee. The enigma of D″. Nature 462, 731–732, 2009.

5. In This Issue. Protean magnetic properties of iron oxide. Proceedings of the National Academy of Sciences 106, 5451, 2009.

4. Advanced Photon Source Science Highlights. New look at deep mantle discontinuity. 2009.

3. What lies at the Earth's core-mantle boundary? Advanced Photon Source Science, 111–112, 2005.

2. Advanced Photon Source Forefront. Probing the nature of seismic discontinuities in the Earth's mantle with synchrotron X-ray beams. 2001.

1. C. R. Bina. Earth science: Mantle cookbook calibration. Nature 411, 536–537, 2001.

Grants

Tags: Shim's recent developments are highlighted with the following symbols.

Solar-system planets and exoplanets Technical developments Educational developments

2025/01–2026/12: NASA-80NSSC25K7172, Sulfur in the Metallic Cores of Super-Earths and its Impact on their Magnetic Fields and Mass-Radius Relations. PI: S.-H. Shim. $633,473; 50% recognition for Shim

2024/08–2026/07: NSF-AST2406790, NSF-BSF Application: Collaborative Research on Reaction between H_2-H_2O Fluid and Silicate, and Implications for Uranus and Neptune. PI: S.-H. Shim. $350,984; 100% recognition for Shim

2024/08–2026/07: NSF-EAR2404972, EAGER: Vibrational Electron Energy Loss Spectroscopy - A New Nanometer Probe for Planetary Materials and Volatiles. PI: S.-H. Shim. $293,045; 100% recognition for Shim

2024/09–2027/08: NASA-80NSSC25K7021, Iron and its Impact in Magma Oceans of Emerging Rocky Planets. PI: S.-H. Shim. $524,788; 100% recognition for Shim

2024/09–2027/08: NSF- EAR2348824, Collaborative Research: Searching for the Origin of ULVZs beneath Antarctica. PI: S. Hansen. $560,319; 10% recognition for Shim

2024/09–2026/08: NSF- EAR2348824, Collaborative Research: Dynamic Compression of Iron-Sulfur Alloys at the Earth's Core Conditions. PI: S.-H. Shim. $99,500; 50% recognition for Shim

2024/02/21–2025/02/20: NSF- EAR2335071, EA: Upgrade of the Laser Heating System in the High-Pressure Diamond-Anvil Cell Laboratory at Arizona State University. PI: S.-H. Shim. $63,872; 100% recognition for Shim

2023/02/01–2026/12/31: NASA-80NSSC23K0362, Hydrogen at the Core-Mantle Boundary of Mars. PI: S.-H. Shim. $445,758; 100% recognition for Shim

2022/10/01–2026/09/30: NASA-80NSSC23K0265, Magma Oceans in Rocky Exoplanets: Understanding Their Dynamic and Magnetic Evolution with New Models and Experiments. PI: J. O'Rourke. $542,369

2022/08/15–2026/07/31: NSF-EAR2153968, Collaborative Research: From Silicate Melts Properties to the Dynamics and Evolution of an Early Basal Magma Ocean. PI: W. Mao (Stanford U.). $249,976 for Shim at ASU

2022/01/11: NSF-EAR2140416, Upgrade of the Raman Spectroscopy System at the High-Pressure Lab of Arizona State University. PI: S.-H. Shim. $85,275; 100% recognition for Shim

2021/10/01–2026/09/30: NSF-EAR2131833, Facility for Open Research in a Compressed Environment (FORCE) at Arizona State University. PI: K. Leinenweber; co-PI: A. Navrotsky, T. Sharp, D. Smith, and S.-H. Shim. $13,711,265; 5% recognition for Shim

2021/08/01–2023/07/31: NSF-AST2108129, Ingassing of Hydrogen in the Interiors of Sub-Neptunes and Gas Giants. PI: S.-H. Shim. $320,615; 100% recognition for Shim

2020/07/01–2022/06/30: NSF-AST2005567, Effect of Hydrogen on the Sulfur-rich Martian Core. PI: S.-H. Shim. $295,000; 100% recognition for Shim

2020/07/01–2022/06/30: NSF-EAR2019565, Possible Storage of H_2O in Mantle $Ca(Ti,Si)O_3$ perovskite. PI: S.-H. Shim. $279,262; 100% recognition for Shim

2019/08/01–2021/07/31: NSF-EAR1921298, Effect of Hydrogen on the Behaviors of Fe Alloys in the Earth's Outer Core. PI: S.-H. Shim; co-PI: A. Chizmeshya. $298,952; 80% recognition for Shim

2019/06/01–2021/05/31: NSF-EAR1855624, Cooperative Studies of The Earth's Deep Interior (CSEDI) Collaborative Research: Ultra-High Velocity Zones (UHVZs) at the Core-Mantle Boundary. PI: E. Garnero; co-PI: M. Li and S.-H. Shim. $544,767; 33% recognition for Shim

2018/01/03–2022/01/02: NASA-80NSSC18K0353, Breaking the Barrier between Ice and Rock – New Mass-Radius Relations for Gas Giant, Icy Giant, Mini-Neptune, and Water World Exoplanets. PI: S.-H. Shim; co-PI: K. Leinenweber and A. Chizmeshya. $559,951; 40% recognition for Shim

2014/12/31–2020/12/30: NASA, Exoplanetary Ecosystems: Exploring Life's Detectability on Chemically Diverse Exoplanets. PI: S. Desch; co-PI: S.-H. Shim among others. $6,097,436; 4% recognition for Shim

2017/06/15–2020/06/15: NSF-EAR1725094, Calcium in Bridgmanite in the Deep Mantle. PI: S.-H. Shim. $271,735; 100% recognition for Shim

2017: Stanford Linear Accelerator Center (SLAC) National Accelerator Laboratory, Materials Synthesis for Laser-Driven Shock Wave Experiments at Linac Coherent Light Source (LCLS). PI: S.-H. Shim. $22,248; 100% recognition for Shim

2016/01/01–2019/12/31: The Keck Foundation, Water from the Heavens: The Origins of Earth's Hydrogen. PI: P. Buseck; co-PI: S.-H. Shim among others. $1,500,000; 14% recognition for Shim

2014/09/01–2016/08/31: NSF-EAR1401270, Cooperative Studies of The Earth's Deep Interior (CSEDI) Collaborative Research: Deep Mantle Cycling of Oceanic Crust. PI: E. Garnero; co-PI: A. McNamara and S.-H. Shim. $818,541; 33% recognition for Shim

2013/09/01–2018/08/31: NSF-FESD-Type I, The Dynamics of Earth System Oxygenation. PI: A. Anbar; co-PI: S.-H. Shim among others. $3,080,000; 5% recognition for Shim

2013/08/01–2016/07/31: NSF-EAR1321976, Hydration of Dense Polymorphs of Silica in Subducting Slabs. PI: K. Leinenweber; co-PI: Shim. $312,839; 33% recognition for Shim

2011/01/01–2015/12/31: NSF-EAR1301813, The Perovskite to Post-Perovskite Phase Boundary in Mantle Rocks. PI: S.-H. Shim. $398,149 ($229,068 transferred to ASU); 100% recognition for Shim

2010/09/01–2015/08/31: NSF-EAR1316022, Cooperative Studies of The Earth's Deep Interior (CSEDI) Collaborative Research: Valence State of Iron in the Lower Mantle. PI: S.-H. Shim; co-PI: Morgan. $330,922 for Shim ($69,447 transferred to ASU)

2009/12/15–2014/11/30: NSF-EAR1316007, Understanding the Complexity near the 660-km Seismic Discontinuity. PI: S.-H. Shim. $360,281 ($58,468 transferred to ASU); 100% recognition for Shim

2008/07/01–2011/06/30: NSF-EAR0757871, Cooperative Studies of The Earth's Deep Interior (CSEDI) Collaborative Research: Multi-scale Analysis of Mantle Discontinuities using Inverse Scattering of *SS* Waves and Experimental Mineral Physics. PI: R. van der Hilst; co-PI: S.-H. Shim. $299,999

2010/06/01–2011/05/30: NSF-DMR0819762, CMSE-Initiative 3. S.-H. Shim as a co-PI. $26,500 for Shim

2008/01/01–2010/12/31: NSF-EAR0738655, Equation of State and Phase Boundary of Post-Perovskite. PI: S.-H. Shim. $259,803; 100% recognition for Shim

2004/07/01–2008/06/30: NSF-EAR0337005, In situ Raman Spectroscopy Study for Phase Diagrams of Mantle Minerals at High Pressure and Temperature. PI: S.-H. Shim. $255,829; 100% recognition for Shim

2004/03/10–2006/03/09: NSF-EAR0337156, Acquisition of a Combined Micro-Raman Spectroscopy and Laser Heating System for in situ High Pressure and High Temperature Studies. PI: S.-H. Shim. $185,244; 100% recognition for Shim

2004: Wade Award, Acquisition of a Double Monochromator for Raman Spectroscopy Measurements at

High Pressure and Temperature. PI: S.-H. Shim. $45,000; 100% recognition for Shim

Courses

Tags: Shim's recent developments are highlighted with the following symbols.

Solar-system planets and exoplanets Technical developments Educational developments

All the courses here are in-person. F: Fall, S: Spring

2026S, 2024F, 2023F, 2022F, 2021F, 2020F: SES230. Coding for Exploration, ASU

2025F: SES598. SESE Knowledge Exploration, ASU

2025F, 2024S, 2022S, 2018F, 2016F, 2014F: GLG494/598. Advanced Mineralogy: Crystallography and Spectroscopy, ASU

2025S, 2023S: SES494/598. Planetary Interiors, ASU

2021S: SES494/598. Data and Computation, ASU

2020S, 2017F, 2015F: GLG494/598. Introduction to Mineral Physics, ASU

2019F: SES130. Coding for Exploration, ASU

2018S: GLG494/598. Exploring Data with Python, ASU

2017S: GLG294/598. Python for Earth Science, ASU

2016S, 2013S: GLG101. Introduction to Geology I (Physical), ASU

2015S, 2014S: GLG305. Dynamic Earth, ASU (co-teach with D. DeVecchio in 2014S)

2014F: GLG591. Archean Geophysics (co-teach with A. Anbar), ASU

2014S: GLG591. Chemical Processes in Earth's Interior, ASU

2013F: GLG598. Planetary Materials, ASU

2011S: 12.591. Hydrogen: from Planetary to Energy Sciences, MIT

2010F: 12.591. Volatiles in the Earth and Planetary Interiors, MIT

2010S–2007S: 12.108. Structure of Earth Materials, MIT

2009F: 12.591. The Core-Mantle Boundary, MIT

2008F, 2004F: 12.575. Introduction to Mineral Physics, MIT

2007S, 2006F, 2006S: 12.080. EAPS Undergraduate Seminar, MIT

2005F: 12.571. Deep Water - Geophysical Prospective, MIT

2005S: 12.581. Phase Transitions in the Earth's Interior, MIT

2004S: 12.570. Structure and Dynamics of the Core-Mantle Boundary Region, MIT

Mentoring

B.S. Thesis

2025: Ava Campbell, Barrett, ASU (expected for May 2026)

2023: Shradha Ravikumar, Barrett, ASU

2019: Britany Kulka, ASU (now Ph.D. student at Oxford University)

2015: Shaela Noble, Barrett Honors College, ASU (now M.S. student at the University of California, Davis, Bidstrup Undergraduate Fellow)

2007: Caitlin Murphy, MIT (now Senior Policy Analyst at the National Renewable Energy Laboratory in Golden, CO)

M.S. Thesis

2019–2021: Britany Kulka, ASU (now Ph.D. student at Oxford University)

2018–2019: Jonathan Dolinschi, ASU (now Ph.D. student at Bayreuth University, Germany)

Ph.D. Thesis

2025–present: Alem Tukić, ASU (expected for 2030)

2021–2025: Xuehui Wei, ASU

2018–2022: Harrison Horn, ASU

2017–2021: Taehyun Kim, Yonsei University

2014–2020: Byeongkwan Ko, ASU (now postdoctoral researcher at Michigan State University)

2014–2019: Huawei Chen, ASU (now Assistant Professor at China University of Geosciences, China)

2005–2011: Krystle Catalli, MIT (now Principal Engineer at Apple, Inc)

Postdoctoral Researchers

2026–present: Xuehui Wei, ASU

2025–present: Allison Pease, ASU

2023–present: Sibo Chen, ASU

2022–present: Taehyun Kim, ASU

2020–2022: Suyu Fu, ASU (now Japan Society for the Promotion of Science (JSPS) postdoctoral fellow at the University of Tokyo)

2017–2021: Hélène Piet, ASU (now research scientist at W. L. Gore & Associates)

2020–2021: Byeongkwan Ko, ASU

2017–2019: Joseph O'Rourke, Exploration Postdoctoral Fellow, ASU (co-advised with Prof. L. Elkins-Tanton; now Associate Professor at ASU)

2016–2018: Cayman Unterborn, Exploration Postdoctoral Fellow, ASU (co-advised with Prof. S. Desch;

now research associate at ASU)

2012–2018: Carole Nisr, ASU (now Professor at Phoenix College)

2012–2014: Yu Ye, ASU (now Associate Professor at China University of Geosciences, China)

2011: Antonio Buono, MIT (now research scientist at ExxonMobil)

2008–2011: Brent Grocholski, MIT (now Senior Editor in journal *Science*)

2006–2007: Justin Hustoft, MIT (now Assistant Professor at Mount Mary University, WI)

2004–2006: Javier Santillán, MIT, Ford Postdoctoral Fellow (now Global CT Manager at Apple, Inc)

2003–2005: Sandeep Rekhi, MIT (now Principal Engineer at Apple, Inc)

Undergraduate Research Program

I advised all the following undergraduate students for the undergraduate research program in my group.

2026–present: Kassandra Amezcua, ASU

2024–present: Ava Campbell, Barrett, ASU

2024–2025: Hamza Ayaz, ASU

2023–2024: Erin Mann, ASU

2021–2023: Shradha Ravikumar, Barrett, ASU

2022: Enzo Carrascal, ASU (now Ph.D. student at Caltech)

2019: Robert Rezvani and Ayla Zustra, Barrett, ASU

2018–2019: Britany Kulka, ASU (now Ph.D. student at Oxford University)

2017–2019: Jacqueline Tappan, ASU (now Staff Hydrogeologist at Leonard Rice Engineers Inc.)

2017: Jonathan Dolinschi, ASU (now Ph.D. student at Bayreuth University, Germany)

2016–2017: Abigail Weibel, ASU (now Project Manager Associate at ASU)

2015–2016: Patrick Kennedy, ASU (now Technologist at Audiolex)

2015–2016: Shaela Noble, ASU (now M.S. student at the University of California, Davis)

2015–2016: Mark Williamson, ASU

2009: Elizabeth George, MIT (now Detector Engineer at European Southern Observatory, Munich, Germany)

2008: Michael DeMeo, Leslie C. Patron Undergraduate Research Opportunity Program, MIT (now Application Engineer at Exa Corporation, Detroit, MI)

2008: Deidre LaBounty, MIT (now graduate student at the University of Alaska Fairbanks)

2007–2008: Rachel Zucker, Leslie C. Patron Undergraduate Research Opportunity Program, MIT (now senior research scientist at Kernel, CA)

2006: Sarah Slotznick, Leslie C. Patron Undergraduate Research Opportunity Program, MIT (now Miller postdoctoral fellow, Department of Earth and Planetary Science, University of California, Berkeley)

2004–2005: Nicholas Leiby, MIT (now Lead Data Scientist at Kyruus, Alexandria, VA)

Visiting Graduate Students

2017–2021: Taehyun Kim, Visiting Ph.D. student from Yonsei University, Korea

2012–2013: Qian Zhang, Visiting Ph.D. student from Peking University, China (now staff scientist at China University of Geosciences)

Thesis Committee Member

These students are not directly mentored by Shim. Shim was a committee member for the dissertation.

2025: Stephanie Sparks (Ph.D.), ASU

2025: Kevin Trinh (Ph.D.), ASU

2022: Qian Yuan (Ph.D.), ASU

2021: Jake Hanson (Ph.D.), ASU

2020: Hannah Shamloo (Ph.D.), ASU

2019: Hongyu Lai (Ph.D.), Shule Yu (Ph.D.), Alyssa Anderson (Ph.D.), Sarah Dillon (M.S.), Emily Garhart (M.S.), and Gabriel Franco (M.S.), ASU

2018: Alejandro Lorenzo (M.S.), ASU

2016: Shkolyar Svetlana (Ph.D.), ASU

2015: Jeffrey Lockridge (Ph.D.) Rebecca Smith (Ph.D.), and Alex Mastrean (B.S.), ASU

2014: Mingming Li (Ph.D.) and Michael Pagano (Ph.D.), ASU

2011: Michael Krawczynski (Ph.D.), and Qin Cao (Ph.D.), and Stephanie Brown (M.S.), MIT

2010: Jay Barr (Ph.D.), MIT

2007: Emily Van Ark (Ph.D.), Guangping Xu (Ph.D.), and Ping Wang (Ph.D.), MIT

2006: Shichun Huang (Ph.D.), MIT

Graduate Students for Second Comprehensive Exam Project

SESE at ASU (and also MIT) requires Ph.D. students to carry out with two separate research projects with two different faculty advisors for their comprehensive exams. Their second projects should involve work in substantially different fields. Shim has regular weekly research meetings with the students for at least 1 semester to ensure sufficient progress in their second research projects.

2025–present: Guangpu Yi

2023–2024: Prachi Kar

2022–2023: Leah Shteynman

2018–2019: Emily Garhart and Gabriel Franco, ASU

2017–2018: Jonathan Hoh and Alexandra Pye, ASU

2015–2017: Alyssa Anderson, ASU

2008–2012: Xuefeng Shang and Nathaniel Dixon, MIT

2004–2006: Rosalee Lamm, MIT

Comprehensive Examination Committees

2024–2025: Marco Lalonde, ASU

2023–2024: Prachi Kar and Yoav Rotman, ASU

2021–2022: Sasha Sypkens and Kevin Trinh, ASU

2020–2021: Camerian Millsaps, Saira Hamid, and Aditya Khuller, ASU

2019–2020: Mariah Heck, Qian Yuan, and Harrison Horn, ASU

2018–2019: Alexandra Pye, Jonathan Hoh, and Sierra Ferguson, ASU

2017–2018: Hanna Shamloo and Jake Hanson (Chair), ASU

2016–2017: Huawei Chen, Byeongkwan Ko, Kara Brugman, and Alyssa Anderson, ASU

2015–2016: Megan Miller (Chair), Julie Mitchell, and Hongyu Lai, ASU

2014–2015: Luke Probst, Ruirui Han, Jinping Hu (Chair), and Christopher Haberle, ASU

2013–2014: Jeffrey Lockridge and Jinping Hu, ASU

2012: Chen Gu, MIT

2009: Qin Cao (Chair), Nathan Dixon, and Xuefeng Shang, MIT

2007: Krystle Catalli, MIT

2006: Jay Barr and Noah McLean, MIT

Service

Tags: Shim's recent developments are highlighted with the following symbols.

Solar-system planets and exoplanets Technical developments Educational developments

University Service

2022–2023: Member of Faculty Search Committee, Facility for Open Research in a Compressed Environment (FORCE), ASU

2022: Member of Research Scientist Search Committee, Facility for Open Research in a Compressed Environment (FORCE), ASU

2021–present: Member of Steering Committee, Facility for Open Research in a Compressed Environment (FORCE), ASU

2019–present: Member of Steering Committee, Center for Materials of the Universe (MOTU), ASU

2019: Chair of Organizing Committee for Workshop on Materials of the Universe (MOTU), ASU

2017–2022: Member of Materials Governance Board, ASU

Unit/Department Service at ASU

2025–present: Chair of Graduate Student Committee, SESE, ASU

2024–2025: Member of Graduate Student Committee, SESE, ASU

2021–2024: Member of SESE Annual Evaluation Committee, SESE, ASU

2023–2024: Member of SESE Award Committee, SESE, ASU

2020–2023: Member of SESE Exploration Postdoctoral Scholar Committee, SESE, ASU

2019–2020: Member of Thermochemistry Faculty Search Committee, School of Molecular Sciences (SMS), ASU

2019–2020: Member of Faculty Annual Evaluation Committee, SESE, ASU

2016–2017: Member of Geophysics Faculty Search Committee, SESE, ASU

2016–2017: Member of Geochemistry Faculty Search Committee, SESE, ASU

2016: Chair of Graduate Student Recruiting Committee, SESE, ASU

2013–2016: Member of Graduate Student Recruiting Committee, SESE, ASU

2012–2013: Chair of Geophysics Faculty Search Committee, SESE, ASU

2012: Member of Award Committee, SESE, ASU

Unit/Department Service at MIT

2009–2010: Member of Graduate Admissions Committee, EAPS, MIT

2008–2009: Member of Graduate Committee, EAPS, MIT

2006–2007: Chair of Independent Activities Period Educational Program Committee, EAPS, MIT

2007: Member of Promotion Committee for Chatterjee to Senior Research Scientist, EAPS, MIT

2006: Member of Theoretical Geophysics Faculty Search Committee, EAPS, MIT

2003–2006: Member of Graduate Admissions Committee, EAPS, MIT

Non-ASU Professional Service

2024–present: Committee Member, American Geophysical Union Mineral and Rock Physics Canvassing Committee

2024–present: Committee Member, Synchrotron Earth and Environmental Science User Community

2022: Organizer, Town Hall Meeting for Facility for Open Research in a Compressed Environment (FORCE), 2022

2019: Organizer, ED52A - Linking Education and Research with Jupyter, Fall American Geophysical Union Meeting, San Francisco, December 9–13, 2019

2019: External Reviewer for Geophysics Faculty Search, Yonsei University, Korea

2018–present: Member, NExSS (Nexus for Exoplanet System Science) Steering Committee, NASA

2017: Organizing Committee Chair, COMPRES Workshop: Software Toolkit, Consortium for Materials Properties Research in Earth Sciences (COMPRES) Annual Meeting, Hyatt Regency Tamaya Resort, Santa Ana Pueblo, NM, July 9–12, 2017

2017: Member, Review panel for the Cooperative Studies of the Earth's Deep Interior (CSEDI) program, National Science Foundation (NSF)

2015: Organizing Committee Chair, Workshop for US Large Multi-Anvil Press Facility (LMAPF), Consortium for Materials Properties Research in Earth Sciences (COMPRES) Annual Meeting, Colorado Springs, CO, July 6, 2015

2015–2018: Member, Facilities Committee, Consortium for Materials Properties Research in Earth Sciences (COMPRES)

2013–2015: Editor, Geophysical Journal International

2013–2020: Member, Advanced Photon Source Proposal Review Panel for High Pressure Science, Argonne National Laboratory

2010–2015: Member, Executive Committee, Mineral and Rock Physics Focus Group, American Geophysical Union (AGU)

2010–2014: Vice Chair, Subcommission for Spectroscopy, Diffraction, and New Instrumentations in Mineral Physics, Commission of Physics of Minerals, International Mineralogical Association (IMA)

2010: Consulting editor, Odyssey - Adventures in Science, Science Magazine for Middle Schoolers, "That Rocks!" issue

2004–2010: Member, Infrastructure Development Committee, Consortium for Materials Properties Research in Earth Sciences (COMPRES)

2008: Member, International Organizing Committee, 4th Asian Conference in High Pressure Research, Seoul, Korea

2004–2006: Associate Editor, American Mineralogist

Journal Article Review

Nature, Science, Nature Geoscience, Science Advances, Geophysical Research Letters, Proceedings of

the National Academy of Sciences, Journal of Geophysical Research, American Mineralogist, Earth and Planetary Science Letters, Physics of the Earth and Planetary Interiors, Physical Review, Journal of Solid State Chemistry

Grant Proposal Review

National Aeronautics and Space Administration (NASA) Exoplanet Research Program, National Science Foundation (NSF) Geophysics, National Science Foundation (NSF) Geochemistry and Petrology, National Science Foundation (NSF) Earth Sciences: Instrumentation and Facilities, National Science Foundation (NSF) Materials Research, European Science Foundation EuroMinSc