

# Professor John William Hernlund

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*Earth-Life Science Institute*  
*Tokyo Institute of Technology*  
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## Education:

- **Ph.D., Geophysics and Space Physics**–University of California, Los Angeles, 2006  
*Los Angeles, CA*
    - Thesis: Dynamics Associated with Partial Melting in Earth’s Uppermost and Lowermost Mantle and the Structure and Phase Relationships in Earth’s D” Layer.
    - Ph.D. Advisor: Paul J. Tackley; Ph.D. Committee: Abby Kavner, Paul Roberts, Gerald Schubert
  - **M.S., Geophysics and Space Physics**–University of California, Los Angeles, 2005  
*Los Angeles, CA*
    - Qualification by Oral Examination
    - M.S. Advisor: Paul J. Tackley.
  - **B.S., Geology**–Arizona State University, Barrett Honors College, 2000  
*Tempe, AZ*
    - Graduation Honors: Magna Cum Laude
    - Thesis: Development of Experimental Methods to Measure the Electrical Conductivity of Olivine at High Pressure and Temperature
    - Advisor: Professor James A. Tyburczy.
    - ASU Geology field camp, 1999, Professor Donald M. Burt.
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## Professional Experience:

- **Full Professor (Tenured), January 2017-Present**–Earth-Life Science Institute, Tokyo Institute of Technology  
*Tokyo, Japan*
  - Teaching duties: 1-2 seminar courses per year and supervision of graduate students.
  - Teaching affiliation: Department of Earth and Planetary Sciences.
- **Vice Director, October 2014-Present**–Earth-Life Science Institute, Tokyo Institute of Technology  
*Tokyo, Japan*
  - Shared responsibility for managing the institute, along with the Director (Kei Hirose) and one other Vice Director (Shigeru Ida).
  - Administrative achievements: Scientific strategy, external relations, reporting and oversight, international recruitment, public relations, visitors, workshops.
- **Principal Investigator, August 2013-Present**–Earth-Life Science Institute, Tokyo Institute of Technology  
*Tokyo, Japan*
  - First full-time non-Japanese PI to join ELSI, during the start-up period.
  - Research achievements: Bridgmanite-Enriched Ancient Mantle Structures (BEAMS) Model; Core Formation, Stratification and Mixing; SiO<sub>2</sub> Crystallization in the Core.

- **Project Specialist, 2012-2013**–University of California, Berkeley  
*Berkeley, California*
    - Principal investigator, National Science Foundation funded grant on core evolution.
    - Research achievements: High Core Conductivity; Melt Accumulation at Lithosphere-Asthenosphere Boundary; Inner Core Snow Models.
  - **Post-Doctoral Fellow, 2009-2012**–University of California, Berkeley  
*Berkeley, California*
    - National Science Foundation funded grant on basal magma ocean evolution.
    - Research achievements: Partitioning and Fractionation in Basal Magma Oceans; Deep Mantle Thermal Conductivity, Limits on Exoplanet Dynamos.
  - **Post-Doctoral Fellow, 2007-2009**–University of British Columbia  
*Vancouver, Canada*
    - Fellow, Canadian Institute for Advanced Research, Earth Systems Evolution Program
    - Research achievements: ULVZ Melting and Dynamics; CMB Heat Flow; Melt Ponding in Transition Zone; Spherical Annulus.
  - **Post-Doctorant, 2006-2007**–Institut de Physique du Globe de Paris  
*Paris, France*
    - Affiliated with Laboratoire Dynamique des Systèmes Géologiques.
    - Research achievements: Basal Magma Ocean; Core Temperature Limits; Deep Mantle Seismic Velocity Distributions.
  - **Graduate Student Researcher, 2001-2006**–University of California, Los Angeles  
*Los Angeles, California*
    - Member of the legendary UCLA Geodynamics group.
    - Research achievements: Post-Perovskite Double-Crossing Model; Theory of Decompression Melting Instabilities; Cubed Sphere Code.
  - **Undergraduate Researcher, 1997-2000**–Arizona State University  
*Tempe, Arizona*
    - Employed half-time conducting experiments in the ASU high pressure laboratory.
    - Research achievements: Multi-Anvil Thermal Model; Experimental Development.
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## Scholarly Awards:

- **Jason Morgan Early Career Award**, American Geophysical Union, 2010.
  - **Durk Doornbos Memorial Prize**, International Union of Geodesy and Geophysics Committee on Study of the Earth's Deep Interior, 2008.
  - **Young Researcher Fellowship Award**, Massachusetts Institute of Technology Conference on Computational Fluid and Solid Mechanics, 2003.
  - **Graduation Award**, College of Liberal Arts and Sciences, Arizona State University, 2000.
  - **Sun Devil Star Award**, Arizona State University, 1999.
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## Community Service Activities and Awards:

- **Reviewer**, Over 300 manuscripts and more than 70 research proposals, 2003-present.
- **Chair and Organizer**, Magma Oceanology Workshop, July, 2016.
- **Co-Chair and Organizer**, Workshop on Transport Properties in the Earth's Core, October, 2013.
- **Editorial Board**, *Physics of the Earth and Planetary Interiors*, 2013-present.

- **Citation for Excellence in Refereeing**, *Geochemistry, Geophysics, Geosystems*, American Geophysical Union, 2012.
  - **Chair**, Gordon Research Seminar on Interior of the Earth, June, 2011.
  - **Co-Chair**, Workshop on Geodynamics of the Lithosphere and Deep Earth (GLADE), July, 2010.
  - **Citation for Excellence in Refereeing**, *Geophysical Research Letters*, American Geophysical Union, 2008.
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## Grants Awarded:

- **Title:** Theoretical modeling of mantle material and dynamics  
**Funding Agency:** Japan Society for the Promotion of Science  
**Award:**≈\$1,000,000 **Grant Period:** 2015-2020 **Role:** Co-I (1 of 6).
  - **Title:** Development of small-size detector for anti-neutrino directionality and construction of “Particle Geoscience”  
**Funding Agency:** Earthquake Research Institute (ERI), University of Tokyo  
**Award:** \$11,000 **Grant Period:** 2015-2016 **Role:** Co-I (1 of 10).
  - **Title:** Earth-Life Science Institute, World Premiere International Research Center  
**Funding Agency:** Ministry of Education, Culture, Sports, Science, and Technology (Japan)  
**Award:** ≈\$100,000,000 **Grant Period:** 2012-2021 **Role:** PI (1 of 15).
  - **Title:** CSEDI: Combined Geodynamical and Seismological Modeling of the Inner Core Boundary Region  
**Funding Agency:** National Science Foundation  
**Award:** \$434,941 **Grant Period:** 2012-2015 **Role:** PI (Co-I: Vernon Cormier).
  - **Title:** CSEDI: Melt stability and dynamics in the deep Earth  
**Funding Agency:** National Science Foundation  
**Award:** \$250,061 **Grant Period:** 2009-2011 **Role:** Author (PI: Michael Manga).
  - **Title:** Heat transfer and phase relations in the Earth’s deep interior  
**Funding Agency:** Ministry of Higher Education and Research (France)  
**Award:** ≈\$100,000 **Grant Period:** 2006-2007 **Role:** Proposer (Host Stéphane Labrosse).
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## Current and Former Research Group:

- **Dr. Marine Lasbleis** (France), Core and Magma Ocean Evolution, 2015-Present.
  - **Dr. Maxim Ballmer** (Germany), Geodynamics, 2014-2015 (now at ETH-Zurich).
  - **Dr. Matthieu Laneuville** (France), Planetary Evolution, 2014-Present.
  - **Dr. Hiroki Ichikawa** (Japan), Computational Geophysics, 2013-Present.
  - **Dr. Christine Houser** (USA), Global Seismology, 2013-Present.
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## Student Mentoring Experience:

- **Jac Van Driel**, University College London (2016-Present).
- **Maude Geissman**, Ecole Normale Supérieure de Paris (2016).
- **Marine Lasbleis**, Ecole Normale Supérieure de Lyon (2011-2015).
- **Hitoshi Gomi**, Tokyo Institute of Technology (2011-2013).
- **Ryuichi Nomura**, Tokyo Institute of Technology (2010-2011).
- **Emma Rainey**, University of California, Los Angeles (2009-2014).

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## Lecture Course Experience:

- **Guest Professor, 2015**–Kyushu University  
*Fukuoka, Japan*
    - Prepared and taught a lecture course titled “The Core-Mantle Boundary.”
  - **Guest Lecturer, 2015**–Tokyo Institute of Technology  
*Tokyo, Japan*
    - Prepared and delivered lectures for a team-style seminar course.
  - **Co-Organizer, 2014**–ELSI Summer School on Computational Methods  
*Tokyo, Japan*
    - In partnership with the Computational Infrastructure in Geodynamics (UC Davis).
  - **Guest Lecturer, 2014**–Tokyo Institute of Technology  
*Tokyo, Japan*
    - Prepared and delivered lectures for a team-style seminar course.
  - **Teaching Assistant, 2005**–University of California, Los Angeles  
*Los Angeles, California*
    - ESS10: Exploring Mars, the Red Planet, with Rubie Professor Ashwin Vasavada.
  - **Teaching Assistant, 2001**–University of California, Los Angeles  
*Los Angeles, California*
    - ESS1: Introduction to Earth and Space Sciences, under Professor Peter Bird.
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## Publications:

- **Published:**
  - Ballmer, M.D., C. Houser, J. Hernlund, R. Wentzcovitch, K. Hirose, Persistence of strong silica-enriched domains in the Earth’s lower mantle, *Nature Geoscience*, **10**:236-240, 2017.
  - Hirose, K., G. Morard, R. Sinmyo, K. Umemoto, J. Hernlund, G. Helffrich, S. Labrosse, SiO<sub>2</sub> crystallization and compositional evolution of the Earth’s core, *Nature*, **543**:99-102, 2017.
  - Hernlund, J.W., Chemistry of Core-Mantle Boundary, in *Deep Earth: Physics and Chemistry of the Lower Mantle and Core*, R. Fischer and H. Terasaki (eds.), American Geophysical Union Monograph, 201-208, 2016.
  - Scharf, C., N. Virgo, H.J.II Cleaves, M. Aono, et al., A strategy for origins of life research, *Astrobiology*, **15**:1031-1042, 2015.
  - Labrosse, S., J.W. Hernlund, and K. Hirose, Fractional Melting and Freezing in the Deep Mantle and Implications for the Formation of a Basal Magma Ocean, in *The Early Earth: Accretion and Differentiation*, Geophysical Monograph 212, J. Badro and M. Walter (eds.), American Geophysical Union, 2015.
  - Hernlund, J.W and A.K. McNamara, Dynamics of the Core-Mantle Boundary Region, *Treatise on Geophysics*, 2nd Edition, **7**:461-519, 2015.
  - Rainey, E.S.G., J. Hernlund, and A. Kavner, Temperature distributions in the laser-heated diamond anvil cell from 3-D numerical modeling, *J. Appl. Phys.*, **114**:204905, 2013.

- Sakamaki, T., A. Suzuki, E. Ohtani, H. Terasaki, S. Urakawa, Y. Katayama, K. Funakoshi, Y. Wang, J.W. Hernlund, M.D. Ballmer, Ponded melt at the boundary between the lithosphere and asthenosphere, *Nature Geoscience*, 10.1038/NGEO1982, 2013.
- Hirose, K., S. Labrosse, and J.W. Hernlund, Composition and state of the core, *Ann. Rev. Earth Planet. Sci.*, **41**:657-691, 2013.
- Gomi, H., K. Ohta, K. Hirose, S. Labrosse, R. Caracas, M.J. Verstraete, and J.W. Hernlund, The high conductivity of iron and thermal evolution of the Earth's core, *Phys. Earth Planet. Int.*, **224**:88-103, 2013.
- Hernlund, J., Deep Earth: Mantle fabric unravelled? *Nature Geosci.*, **6**:516-518, 2013.
- Ohta, K., T. Yagi, N. Taketoshi, K. Hirose, T. Komabayashi, T. Baba, Y. Ohishi, and J. Hernlund, Lattice thermal conductivity of MgSiO<sub>3</sub> perovskite and post-perovskite at the core-mantle boundary, *Earth Planet. Sci. Lett.* **349-350**:109-115, 2012.
- Coltice, N., M. Moreira, J. Hernlund, and S. Labrosse, Helium and Neon in mantle plumes record the crystallization of a basal magma ocean, *Earth Planet. Sci. Lett.*, **308**:193-199, 2011.
- Nomura, R., H. Ozawa, S. Tateno, K. Hirose, J. Hernlund, S. Muto, H. Ishii, and N. Hiraoka, Spin crossover and iron-rich silicate melt in the Earth's deep mantle, *Nature*, **473**:199-202, 2011.
- Gaidos, E., M. Manga, J.W. Hernlund, and C. Conrad, Thermodynamic limits on magnetodynamos in rocky exoplanets, *Astrophysical Journal*, **718**:596-609, 2010.
- Hernlund, J.W., On the interaction of the geotherm with a post-perovskite phase transition in the deep mantle, *Phys. Earth Planet. Inter.*, **180**:222-234, 2010.
- Hernlund, J.W. and A.M. Jellinek, Dynamics and structure of a stirred partially molten ultralow velocity zone, *Earth Planet. Sci. Lett.*, **296**:1-8, 2010.
- Lee, C-T., P. Luffi, T. Höink, J. Li, R. Dasgupta, J.W. Hernlund, Upside-down differentiation and generation of a primordial lower mantle, *Nature*, **463**:930-935, 2010.
- Hernlund, J.W. and P.J. Tackley, Modeling mantle convection in the 'Spherical Annulus', *Phys. Earth Planet. Inter.*, **171**: 48-54, 2008.
- Hernlund, J.W., P.J. Tackley, and D.J. Stevenson, Buoyant melting instabilities beneath extending lithosphere, 1. Numerical models, *J. Geophys. Res.*, **113**:B04405, 2008.
- Hernlund, J.W., D.J. Stevenson, and P.J. Tackley, Buoyant melting instabilities beneath extending lithosphere, 2. Linear analysis, *J. Geophys. Res.*, **113**:B04406, 2008.
- Hernlund, J.W. and C. Houser, On the distribution of seismic velocities in Earth's deep mantle, *Earth Planet. Sci. Lett.*, **265**:423-437, 2008.
- Lay, T., J. Hernlund, and B.A. Buffett, Core-mantle boundary heat flow, *Nature Geosci.*, **1**:25-32, 2008.
- Labrosse, S., J.W. Hernlund, and N. Coltice, A crystallizing dense magma ocean at the base of the Earth's mantle, *Nature*, **450**:866-869, 2007.
- Tackley, P.J., T. Nakagawa, and J.W. Hernlund, Influence of the post-perovskite transition on thermal and thermo-chemical mantle convection, *Post-Perovskite: The Last Mantle Phase Transition*, AGU Monograph, 2007.
- Hernlund, J.W. and P.J. Tackley, Some dynamical consequences of partial melting at the base of Earth's mantle, *Phys. Earth Planet. Inter.*, **162**:149-163, 2007.
- Hernlund, J.W. and S. Labrosse, Geophysically consistent values of the perovskite to post-perovskite transition Clapeyron slope, *Geophys. Res. Lett.*, **34**:L05309, 2007.
- Lay, T., J. Hernlund, E.J. Garnero, and M.S. Thorne, A post-perovskite lens and D" heat flux beneath the central Pacific, *Science*, **314**:1272-1276, 2006.

- Hernlund, J.W., K. Leinenweber, D. Locke, and J.A. Tyburczy, A numerical model for steady-state temperature distributions in solid-medium high-pressure cell assemblies, *American Mineralogist*, **91**:295-305, 2006.
- Tackley, P.J., S. Xie, T. Nakagawa, and J.W. Hernlund, Experimental studies of mantle convection: Philosophy, accomplishments and thermo-chemical structure and evolution, in: *Earth's Deep Mantle: Structure, Composition, and Evolution*, AGU Monograph, 85-102, 2005.
- Hernlund, J.W., C. Thomas, and P.J. Tackley, A doubling of the post-perovskite phase boundary and structure of the Earth's lowermost mantle, *Nature*, **434**:882-886, 2005.
- Hernlund, J.W. and P.J. Tackley, Three-dimensional spherical shell convection at infinite prandtl number using the 'Cubed Sphere' method. *Proceedings of the Second M.I.T. Conference on Computational Fluid and Solid Mechanics*, 2003.

● **Citation Statistics:**

- Google Scholar Profile: <http://tinyurl.com/lte3slx>
- Number of Citations: 1,961
- Average Citation Rate: 65
- H-Index: 20
- Academic Age: 10 years since Ph.D.

## Invited Lectures and Seminars:

- Workshop on Planetary Diversity, Tokyo (November, 2016).
- Before the Moon Workshop, Tokyo (November, 2016).
- 1st Asia-Pacific Workshop on Lithosphere and Mantle Dynamics, Taipei (September, 2016).
- Center for Earth Evolution and Dynamics, University of Oslo, (October, 2016).
- Kyushu University, Fukuoka (November, 2015).
- International Institute for Carbon Neutral Energy Research, Fukuoka (November, 2015).
- Institute for the Physics and Mathematics of the Universe, Tokyo (July, 2015).
- American Geophysical Union Fall Meeting, San Francisco (December, 2014).
- Tohoku University, Sendai (November, 2014).
- Geological Society of London, UK (September, 2014).
- Bayerisches Geoinstitut, Bayreuth University, Germany (September, 2014).
- 10th Anniversary of Post-Perovskite, Bristol University (May, 2014).
- Earthquake Research Institute, Tokyo University (January, 2014).
- American Geophysical Union Fall Meeting, San Francisco (December, 2013).
- American Geophysical Union Fall Meeting, San Francisco (December, 2012).
- California Institute of Technology, Pasadena (February, 2012).
- American Geophysical Union Fall Meeting, San Francisco (December, 2011).
- University of Utah, Salt Lake City (November, 2011).
- University of California, Santa Cruz (April, 2011).
- American Geophysical Union Fall Meeting, San Francisco (December, 2010).
- Carnegie Institution of Washington, D.C. (November, 2010).
- University of Maryland, Baltimore (November, 2010).
- University of California, Davis (October, 2010).
- European Geophysical Union Meeting, Vienna (May, 2010).
- Yale University, Connecticut (April, 2010).
- Tokyo Institute of Technology, Japan (March, 2010).
- American Geophysical Union Fall Meeting, San Francisco (December, 2009).
- Rice University, Houston (October, 2009).
- University of California Department Colloquium, Berkeley (September, 2009).

- European Workshop on Numerical Modeling of Mantle Convection and Lithospheric Dynamics, Switzerland (July, 2009).
  - COMPRES Annual Meeting Keynote Lecture, New Hampshire (June, 2009).
  - Tokyo Institute of Technology, Tokyo, (March, 2009).
  - Water Dynamics Symposium, Sendai (March, 2009).
  - Tohoku University, Sendai (February, 2009).
  - University of California, Los Angeles (February, 2009).
  - California Institute of Technology, Pasadena (February, 2009).
  - American Geophysical Union Fall Meeting, San Francisco (December, 2008).
  - Workshop on Transport Properties in Earth's Deep Mantle, Yunishigawa Onsen (October, 2008).
  - Goldschmidt Conference, Vancouver (July, 2008).
  - University of California, Santa Cruz (April, 2008).
  - Scripps Institution of Oceanography (April, 2008).
  - American Geophysical Union Fall Meeting, San Francisco (December, 2007).
  - University of Southern California, Los Angeles (November, 2007).
  - Earth and Ocean Sciences, University of Liverpool (March, 2007).
  - Laboratoire des Sciences de la Terre, École Normale Supérieure de Lyon (February, 2007).
  - Laboratoire de Géophysique Interne et Tectonophysique (LGIT), Grenoble (November, 2006).
  - Institut für Geophysik, Eidgenössische Technische Hochschule (ETH), Zürich (May, 2006).
  - Hewett Club Lecture, University of California, Riverside (October, 2005).
  - Geology Seminar, California State University, Northridge (September, 2005).
  - VLAB Workshop, University of Minnesota (July, 2005).
  - Earth and Planetary Sciences, Washington University (July, 2005).
  - Seismo-seminar, California Institute of Technology (June, 2005).
  - D.E.E.P. Seminar, Arizona State University (May, 2005).
  - Institute of Geophysics and Planetary Physics Seminar, Los Angeles, (April, 2005).
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## **Brief Summary of Scientific Expertise:**

- Broadly inter-disciplinary integrative geodynamical modeling.
- Fluid and solid mechanics, heat and mass transfer.
- High pressure/high temperature materials behavior.
- Planetary thermal, chemical, and magnetic evolution.
- Seismological analysis and simulation.
- Field geology, geological mapping.

## **Brief Summary of Administrative Skills and Accomplishments:**

- Establishment of the Earth-Life Science Institute (ELSI).
- Organizational structure, administrative load balancing, sound principles of governance.
- International scientific recruitment, with emphasis on post-doctoral to senior level.
- Management and supervision of both scientific and administrative staff.
- Conflict resolution in a broadly multi-cultural setting.
- Application for, and management of, large private foundation grants.
- Organization of both large conferences and small workshops.
- Public relations, promotion and outreach, international relations.
- Grant reporting, assessment, and compliance (both public and private).
- Institutional reform, internationalization, cultural integration.
- Non-profit organization establishment and management.