

Zachary M. Geballe

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Education: B.S. Physics, University of Michigan, Ann Arbor, Spring 2008.
Ph.D. Earth and Planetary Science, University of California, Berkeley, Fall 2014.
Thesis: *Melting at the High Pressures of Planetary Interiors*

Employment: 2014-2019 Postdoc, Carnegie Geophysical Laboratory
2019- Research Scientist, Carnegie Geophysical Laboratory

Honors and Awards

2017 Carnegie Postdoctoral Innovation and Excellence Award.
2014 Carnegie Postdoctoral Fellowship.
2014 Mineral and Rock Physics Graduate Research Award, American Geophysical Union.
2013 Student Fellowship, Carnegie-DOE Alliance Center.
2011 Best paper in *Geofluids*.
2009 NSF Graduate Student Fellowship (Geophysics).

Teaching Experience

Teaching Assistant for Planetary Astrophysics, UC Berkeley, Spring 2013.
Teaching Assistant for Computer Simulations in Earth Science, UC Berkeley, Fall 2009.
Physics Help-Room Tutor, University of Michigan, 2007 – 2008.

Peer Reviewed Publications

Google scholar: [Zachary M. Geballe](#)

- 21) **ZM Geballe**, N Sime, J Badro, PE van Keken, AF Goncharov (2020) Thermal conductivity near the bottom of the Earth's lower mantle: measurements of pyrolite up to 120 GPa and 2500 K, *Earth Planet. Sci. Lett.*, 536, 116161, doi.org/10.1016/j.epsl.2020.116161
- 20) T Pakornchote, **ZM Geballe**, U Pinsook, T Taychatanapat, W Busayaporn, AF Goncharov (2020) Raman spectroscopy on hydrogenated graphene under high pressure, *Carbon*, 156, 549-557, doi.org/10.1016/j.carbon.2019.09.077
- 19) S Jiang, N Holtgrewe, **ZM Geballe**, SS Lobanov, MF Mahmood, RS McWilliams, AF Goncharov (2019) A Spectroscopic Study of the Insulator–Metal Transition in Liquid Hydrogen and Deuterium, *Advanced Science*, 1901668, doi.org/10.1002/advs.201901668
- 18) Y Wang, X Zhang, S Jiang, **ZM Geballe**, T Pakornchote, M Somayazulu, VB Prakapenka, E Greenberg, AF Goncharov (2019) Helium-hydrogen immiscibility at high pressures, *J. Chem Phys.*, 150, 114504, doi.org/10.1063/1.5086270
- 17) M Somayazulu, M Ahart, AK Mishra, **ZM Geballe**, M Baldini, Y Meng, VV Struzhkin, RJ Hemley (2019) Evidence for Superconductivity above 260 K in Lanthanum Superhydride at

Megabar Pressures, *Phys. Rev. Lett.*, 122, 027001, doi.org/10.1103/PhysRevLett.122.027001.
Highlighted in *Gizmodo*, April 2019 and *Scientific American*, October 2019.

- 16) H Liu, II Naumov, **ZM Geballe**, M Somayazulu, JS Tse, RJ Hemley (2018) Dynamics and superconductivity in compressed lanthanum superhydride, *Phys. Rev. B.*, 98, 100102(R), doi.org/10.1103/PhysRevB.98.100102
- 15) AK Mishra, T Muramatsu, H Liu, **ZM Geballe**, M Somayazulu, M Ahart, M Baldini, Y Meng, E Zurek, RJ Hemley (2018) New Calcium Hydrides with Mixed Atomic and Molecular Hydrogen, *J. Phys. Chem. C*, 122(34), 19370-19378, doi.org/10.1021/acs.jpcc.8b05030
- 14) **ZM Geballe**, H Liu, AK Mishra, M Ahart, M Somayazulu, Y Meng, M Baldini, RJ Hemley (2018) Synthesis and Stability of Lanthanum Superhydrides, *Angew. Chem. Int. Ed.*, 57, 688-692, doi.org/10.1002/ange.201709970.
- 13) AF Goncharov, **ZM Geballe** (2017) Comment on “Evidence of a first-order phase transition to metallic hydrogen”. *Phys. Rev. B*, 96, 157101, doi.org/10.1103/PhysRevB.96.157101
- 12) **ZM Geballe**, VV Struzhkin (2017) AC calorimetry of H₂O at pressures up to 9 GPa in diamond anvil cells. *J. Appl. Phys.*, 121, 245901, doi.org/10.1063/1.4989849
- 11) **ZM Geballe**, VV Struzhkin, A Townley, R Jeanloz (2017) Modulation calorimetry in diamond anvil cells. II. Joule-heating design and prototypes, *J. Appl. Phys*, 121, 145903, doi.org/10.1063/1.4979850
- 10) **ZM Geballe**, GW Collins, R Jeanloz (2017) Modulation calorimetry in diamond anvil cells. I. Heat flow models, *J. Appl. Phys*, 121, 145902, doi.org/10.1063/1.4979849
- 9) SV Raju, **ZM Geballe**, BK Godwal, B Kalkan, Q Williams and R Jeanloz (2014) High pressure and temperature structure of liquid and solid Cd: implications for the melting curve of Cd, *Materials Research Express*, 1, 046502, doi.org/10.1088/2053-1591/1/4/046502
- 8) **ZM Geballe** and R Jeanloz (2014) Solid phases of FeSi to 47 GPa and 2800 K: New data. *American Mineralogist*, 99, 4, 720-723, doi.org/10.2138/am.2014.4612
- 7) **ZM Geballe**, SV Raju, BK Godwal and R Jeanloz (2013) Clapeyron slope reversal in the melting curve of AuGa₂ at 5.5 GPa. *J. Phys: Condens. Matter* 25, 415401, doi.org/10.1088/0953-8984/25/41/415401
- 6) **ZM Geballe**, M Lasbleis, VF Cormier, EA Day (2013) Sharp hemisphere boundaries in a translating inner core. *Geophys. Res. Lett.*, 40, [doi:10.1002/grl.50372](https://doi.org/10.1002/grl.50372)
- 5) BK Godwal, SV Raju, **Z Geballe** and R Jeanloz (2012) Electronic phase transitions in cadmium at high pressures. *J. Phys.: Conf. Ser.* 377 012033, doi.org/10.1088/1742-6596/377/1/012033
- 4) **ZM Geballe** and R Jeanloz (2012) Origin of temperature plateaus in laser-heated diamond anvil cell experiments *J. Appl. Phys.* 111, 123518, doi.org/10.1063/1.4729905
- 3) M Millot, **ZM Geballe**, KM Yu, W Walukiewicz, R Jeanloz (2012) Red-green luminescence in indium gallium nitride alloys investigated by high pressure optical spectroscopy, *Appl. Phys. Lett.*, 100, 162103, doi.org/10.1063/1.4704367
- 2) **ZM Geballe**, C-Y Wang, M Manga (2011) A permeability-change model for water level

changes triggered by teleseismic waves, *Geofluids*, 11, 3, 302-308, [doi: 10.1111/j.1468-8123.2011.00341.x](https://doi.org/10.1111/j.1468-8123.2011.00341.x)

- 1) J Yan, J Knight, M Kunz, SV Raju, B Chen, AE Gleason, BK Godwal, **Z Geballe**, R Jeanloz, SM Clark (2010) The resistive-heating characterization of laser heating system and LaB₆ characterization of X-ray diffraction of beamline 12.2.2 at advanced light source, *J Phys Chem Solids*, 71, 8, 1179-1182, doi.org/10.1016/j.jpcs.2010.03.030

Manuscripts in preparation and review

ZM Geballe, N Holtgrewe, E Greenberg, VB Prakapenka, AF Goncharov, Melting of platinum to 100 GPa, 4000 K: detection of jumps in enthalpy and resistance, in preparation.

ZM Geballe, SM Arveson, S Speziale, R Jeanloz, Evidence for a well-defined thermodynamic states in amorphous CaSiO₃, in preparation.

Professional Service

Organizing Committees: Member of COMPRES Committee on Education, Outreach, and Infrastructure Development, 2019-present

Funding agency reviews: NASA Emerging Worlds Program, NASA FINESST Program.

Journal reviews: *Physical Review Letters*, *Physical Review B*, *Journal of Applied Physics*, *American Mineralogist*, *Inorganic Chemistry*, *Chinese Optical Letters*, *Frontiers In Earth Science*, *Pure and Applied Geophysics*

Conference service: Session chair at 2015 APS March meeting, co-organizer of 2015-2018 poster sessions for local scientists at Carnegie's Broad Branch Road campus.

Outreach activities

2015-2018 DC STEM science fair judge

2013-2014 Presenter/tutor at elementary schools through BASIS program (Bay Area Scientists in Schools)

Presentations

2019

ZM Geballe, N Holtgrewe, E Greenberg, VB Prakapenka, AF Goncharov, *Pulsed electrical melting of transition metals in diamond anvil cells: a new probe to determine the Earth's core temperature*. Oral presentation at the AGU Fall Meeting.

ZM Geballe, *Experimental probes of heat flow from the Earth's inner core to lower mantle*. Princeton Brown Bag, November 8, 2019.

ZM Geballe, N Sime, PE van Keken, AF Goncharov, *FEniCS heat flow models connect micron-lengthscale experiments to the 100 km-thick thermal boundary layer at base of the Earth's mantle*. Oral presentation at the FEniCS'19 workshop.

2018

ZM Geballe, N Sime, PE van Keken, AF Goncharov *Thermal conductivity at the base of the Earth's lower mantle*. Oral presentation at the AGU Fall Meeting.

ZM Geballe, *Microjoules and Megabars: Dynamic heating experiments that probe the Earth's interior and create exotic materials*. Geophysical Lab Seminar, May 21, 2018.

ZM Geballe, *Thermodynamics of melting, freezing, and glass formation at high pressure*. Condensed Matter Physics Seminar, University of Maryland, March 29, 2018 & Photon Science Seminar, SLAC National Laboratory, March 15, 2018.

ZM Geballe, *Pulsed-heating and calorimetry of melting, freezing and glass formation at high pressures*. Lawrence Livermore National Laboratory Shock Physics Seminar, March 12, 2018.

ZM Geballe, H Liu, AK Mishra, M Ahart, M Somayazulu, Y Meng, M Baldini, RJ Hemley, *Synthesis and Stability of Lanthanum Superhydride*. Oral presentation at the APS March Meeting.

2017

ZM Geballe, K Hemawan, RJ Hemley, *Noble metal electrodes encapsulated in diamond for laboratory tests of high-pressure, high-temperature superconductivity in hydrogen-rich materials*. Oral presentation at the APS March Meeting.

ZM Geballe, *Where is heat stored in solids and liquids?* Lunch and Learn Seminar, Carnegie Institution for Science, Jan 18, 2017.

2016

ZM Geballe, *Melting, freezing and glass-formation at the extreme pressures found inside the Earth*, Physics Department Colloquium, Howard University, Oct 11, 2016.

ZM Geballe, *High-pressure calorimetry: a new experimental tool and its application to H₂O*. Geophysical Lab Seminar, Aug 1, 2016.

ZM Geballe, VV Struzhkin, *High-pressure thermal properties of liquid, solid and amorphous H₂O*. Oral presentation at the APS March Meeting.

2015

ZM Geballe, Z Whitlock, VV Struzhkin, *High-pressure thermal properties of liquid, solid and amorphous H₂O*. Poster presentation at the AGU Fall Meeting.

ZM Geballe, VV Struzhkin, *Calorimetry at high-pressure using high-frequency Joule-heating*. Oral presentation at the APS March Meeting, San Antonio, TX.

2014

ZM Geballe, A Townley, R Jeanloz, *How to measure heat capacity of metals at 10s to 100s of GPa*, Poster presentation at the AGU Fall Meeting.

ZM Geballe, *A new laboratory technique to understand melting and freezing in planetary interiors*. Geology Department Colloquium, University of Maryland, December 5th, 2014.

ZM Geballe, A Townley, GW Collins and R Jeanloz, *Development of high-frequency calorimetry for high-pressure heat capacity measurements*. Poster presentation at High Pressure Gordon Research Conference.

ZM Geballe, SM Arveson, S Speziale and R Jeanloz. *Broad range of meta-stability of amorphous CaSiO₃: from 0 to 45 GPa, regardless of synthesis route*. Poster presentation at 2014 CDAC workshop, Bethesda, MD.

2013

ZM Geballe, SM Arveson, S Speziale and R Jeanloz. *High-pressure elasticity of two types of CaSiO₃: melt-quenched and pressure-amorphized*. Unofficial poster presentation at the AGU Fall meeting.

ZM Geballe, GW Collins and R Jeanloz. *Possibilities and Limitations of AC Calorimetry in diamond anvil cells*. Oral presentation at the AIRAPT/APS-SCCM joint conference in Seattle, WA.

2012

ZM Geballe, M Lasbleis, EA Day and V Cormier. *Sharp hemisphere boundaries in a translating inner core*. Oral presentation at CIDER workshop, December, 2012.

ZM Geballe and R Jeanloz. *Solid phases of FeSi to 45 GPa and 2500 K*. Poster at AGU Fall Meeting, 2012.

ZM Geballe and R Jeanloz. *Solid phases of FeSi to 45 GPa and 2500 K*. Poster at CIDER summer workshop, Santa Barbara.

2011

ZM Geballe, R Jeanloz. *Sources of Temperature Plateaus in Laser-Heater Diamond Cell Experiments*. Poster at 2011 AGU Fall Meeting.

2010

ZM Geballe, SV Raju, LR Benedetti, BK Godwal, R Jeanloz. *Melting and Freezing of Fluorite Structured AuGa₂ to 10 GPa*. Poster at 2010 AGU Fall Meeting.

2009

ZM Geballe, Y Robiou du Pont, DS Dreger, C-Y Wang *Water-level oscillations in response to S- and Love waves*. Poster at 2009 AGU Fall Meeting

ZM Geballe, *The 32 Symmetries of Crystal Lattices*. Stanford University Mathematical Organization Speaker, March 11, 2009.