

# Aaron S. Wolf

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## Contact Information

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## Education

- California Institute of Technology, Pasadena, CA USA
  - **Ph.D., Planetary Science**, May 2013
  - Thesis: “Probing the Thermodynamic Properties of Mantle Rocks in Solid and Liquid States”
- California Institute of Technology, Pasadena, CA USA
  - **M.S., Planetary Science**, June 2009
- University of California, Santa Cruz, Santa Cruz, CA USA
  - **B.S., Physics**, June 2006
  - **B.S., Earth Sciences**, June 2006
  - Thesis: “Spin History of the Extrasolar Planetary System HD149026”

## Academic Employment

- Assistant Research Scientist, 2015 - **present**, *University of Michigan*
- Turner Postdoctoral Fellow, 2014, *University of Michigan* • Host: Rebecca Lange
- Postdoctoral Scholar, 2013 - 2013, *Caltech* • Advisor: Paul D. Asimow
- Graduate Research Assistant, 2006 - 2013, *Caltech* • Advisors: Jennifer M. Jackson and Paul D. Asimow
- Primary Research Assistant, 2006, *UC Santa Cruz* • Advisor: Gregory P. Laughlin
- Undergraduate Research Assistant, 2003 - 2005, *UC Santa Cruz* • Advisor: Gregory P. Laughlin
- Research Experience for Undergraduates, Summer 2003, *Cornell* • Advisors: Donald Campbell and Lynn Carter

## Teaching Experience

- Seminar Organizer/Leader, *Mineral-Rock-Melts Reading Group*: Winter 2013-4, Fall & Winter 2014-5, Fall & Winter 2015-6, Fall & Winter 2016-7, Fall & Winter 2017-8, Fall 2018-9
- Teaching Assistant/Co-teacher, *Statistics and Bayesian Data Analysis*: Winter 2013
- Teaching Assistant, *Thermodynamics of Geologic Systems*: Spring 2011
- Teaching Assistant, *Planetary Structure and Evolution*: Fall 2008, Winter 2010
- Teaching Assistant, *Mineralogy (Lecture & Lab)*: Fall 2007

## Advising Student Research

### Past Students

- Dr. Sean Hurt (former graduate student) - Melt Thermodynamics of Alkaline Earth Carbonates: Fall 2014 - Summer 2018, **\*\*co-advised Ph.D. thesis with Rebecca Lange\*\***
- Arielle Joiner (undergrad) - Atomic Structure of Molten Rocks at Extreme Conditions: Fall 2016 - Summer 2018
- Rong Zhou (former undergrad) - Unified High Pressure and Temperature Equations of State: Fall 2014 - Winter 2015

- Wardah Mohammad Fadil (former undergrad) - Unified High Pressure and Temperature Equations of State: Fall, Winter 2014

## Current Students

- Alexander Tye (graduate student) - Statistical Modeling of Detrital Zircon Age Distributions: Summer 2015 - **present**
- Jenna Adams (graduate student, UCSB) - Thermodynamic Modeling of Ti-bearing Garnets: Spring 2017 - **present**
- Lucy Tweed (graduate student, Columbia) - Simplified Thermodynamics & Kinetics of Reactive Transport: Winter 2018 - **present**
- Nikita La Cruz (graduate student) - Inferring Mineral Deposit Formation from Apatite Chemical Analyses: Fall 2016 - **present**
- YoungJae Kim (graduate student) - Thermodynamic Mixing Properties of Alunite supergroup minerals: Winter 2018 - **present**

## Awards and Honors

- Outstanding Research Mentor–Honorable Mention (University Undergraduate Research Opportunity Program, UROP, *Univ. of Michigan*), 2017
- Turner Postdoctoral Fellowship (*Univ. of Michigan Earth & Environmental Science fellowship*), 2014
- AGU Outstanding Student Paper Award (*Mineral and Rock Physics*), 2012
- AGU Outstanding Student Paper Award (*Mineral and Rock Physics*), 2008
- NSF Graduate Research Fellowship, 2007-2010
- Moore Fellowship (*Caltech institute fellowship*), 2006-2007
- Steck Award (*UC Santa Cruz award for the finest senior thesis*), 2006
- Chancellor's and Dean's Undergraduate Awards (*UC Santa Cruz awards recognizing outstanding senior theses*), 2006
- Thimann Scholarship (*UC Santa Cruz award for student with highest promise in natural sciences*), 2006
- Fridley Scholarship (*UC Santa Cruz award for outstanding student in physical sciences*), 2005
- Outstanding Senior in Earth Sciences (*UC Santa Cruz department graduation*), 2005
- Barry M. Goldwater Scholarship (*Honorable Mention*), 2004
- UC Regents Scholarship, 2001-2004

## Funding

**Total PI funding raised = \$1,073,648**

- Alkaline-Earth Carbonate Melts at Deep Earth Conditions
  - NSF Collaborative Studies of the Earth's Deep Interior (CSEDI)
  - Lead PI = **Aaron S. Wolf** (co-PIs = Jie Li & Rebecca A. Lange)
  - Total = \$680,031
  - Apr 2018—Mar 2021
- Collaborative Research: Calibration of Thermochemical Models using Bayesian Methods—Building MELTS 2.0
  - NSF Petrology and Geochemistry
  - Lead PI = **Aaron S. Wolf** (co-PI = Mark S. Ghiorso)
  - Total = \$248,226
  - July 2017—June 2020

- To integrate modeling of melts and fluids for the 4D Deep Carbon in Earth Model of the Deep Carbon Observatory
  - subcontract with OFM Research of Alfred P. Sloan Foundation sourced funding
  - Total = \$145,391
  - subcontract PI = **Aaron S. Wolf**)
  - Jan 2017—July 2019

## Publications

### Citation Metrics (Apr 2019)

- *Google Scholar*: **h-index = 14**, **i10-index = 15**, citations = 1577
- *Scopus*: **h-index = 14**, citations = 1046, (Author ID = 10039345400)

◦ underline indicates student advisee

### In Prep

- **Wolf**, A. S. and Bower, D. J., Constraining the Mantle Liquidus and the impact on Magma Ocean Crystallization. *Earth and Planetary Science Letters*
- **Wolf**, A. S., Ghiorso, M. S., Bayesian calibration of geological thermodynamic databases. *American Journal of Science*.
- Hurt, S., **Wolf**, A. S., Anomalous structure of MgCO<sub>3</sub> liquid and the buoyancy of carbonatite melts. *Earth and Planetary Science Letters*
- Adams, J., **Wolf**, A. S., Spera, J., Ghiorso, M., A new seven-component solution model for garnet and application to genesis of ocean island basalts. *Geochimica et Cosmochimica Acta*

### Accepted

1. Tye, A. R., **Wolf**, A. S., Niemi, N. A., Bayesian Population Correlation: A probabilistic approach to inferring and comparing population distributions for detrital zircon ages. *Chemical Geology*.

### Published

1. Cruz, N. L. L., Simon, A. C., **Wolf**, A. S., Reich, M., Barra, F., Gagnon, J. E. (2019), The geochemistry of apatite from the Los Colorados iron oxide – apatite deposit, Chile: Implications for ore genesis. *Mineralium Deposita*.
2. Kim, Y.J., **Wolf**, A. S., Becker, U. (2019), Thermodynamic mixing properties of alunite supergroup minerals: Quantum-mechanical modeling and statistical thermodynamic analysis of sulfate, chromate, selenate, phosphate, and arsenate solid solutions, as well as uranyl incorporation. *Geochimica et Cosmochimica Acta*.
3. Hurt, S., **Wolf**, A. S. (2018), Thermodynamic properties of CaCO<sub>3</sub>-SrCO<sub>3</sub>-BaCO<sub>3</sub> liquids: a molecular dynamics study using new empirical atomic potentials for alkaline earth carbonates. *Physics and Chemistry of Minerals*, 1–16.
4. **Wolf**, A. S., Bower, D. J. (2018), An equation of state for high pressure-temperature liquids (RTpress) with application to MgSiO<sub>3</sub> melt. *Physics of the Earth and Planetary Interiors*, 278: 59–74.
5. Jackson, A., Parker, R. L., Sambridge, M., Constable, C., **Wolf**, A. S., (2018), The inverse problem of unpolarized infrared spectroscopy of geological materials: Estimation from noisy random sampling of a quadratic form. *American Mineralogist*, 103 (8): 1176–1184.

6. Bower, D. J., Sanan, P. D., **Wolf**, A. S. (2018), Numerical solution of a non-linear conservation law applicable to the interior dynamics of partially molten planets. *Physics of the Earth and Planetary Interiors*, 274: 49–62.
7. **Wolf**, A. S., Asimow, P. D., Stevenson, D. J. (2015), Coordinated Hard Sphere Mixture (CHaSM): A simplified model for oxide and silicate melts at mantle pressures and temperatures. *Geochimica et Cosmochimica Acta*, 163:40–58,
8. **Wolf**, A. S., Jackson, J. M., Dera, P., Prakapenka, V. B. (2015), The thermal equation of state of (Mg, Fe)SiO<sub>3</sub> bridgmanite (perovskite) and implications for lower mantle structures. *J. Geophys. Res. Solid Earth*, 120:7460–7489,
9. Keppel-Aleks, G., **Wolf**, A. S., Mu, M., Doney, S. C., Morton, D. C., Kasibhatla, P. S., Miller, J. B., Dlugokencky, E. J., Randerson, J. T. (2014), Separating the influence of temperature, drought, and fire on interannual variability in atmospheric CO<sub>2</sub>. *Global Biogeochem. Cycles*, 28:1295–1310,
10. Line, M. R., Knutson, H., **Wolf**, A. S., Yung, Y. L. (2014), A Systematic Retrieval Analysis of Secondary Eclipse Spectra. II. A Uniform Analysis of Nine Planets and their C to O Ratios. *The Astrophysical Journal*, 783:70,
11. O’Rourke, J. G., **Wolf**, A. S., Ehlmann, B. L. (2014), Venus: Interpreting the spatial distribution of volcanically modified craters. *Geophys. Res. Lett.*, 41:8252–8260,
12. Line, M. R., **Wolf**, A. S., Zhang, X., Knutson, H., Kammer, J. A., Ellison, E., Deroo, P., Crisp, D., Yung, Y. L. (2013), A Systematic Retrieval Analysis of Secondary Eclipse Spectra. I. A Comparison of Atmospheric Retrieval Techniques. *The Astrophysical Journal*, 775:137,
13. Hayes, A. G., **Wolf**, A. S., Aharonson, O., Zebker, H., Lorenz, R., Kirk, R. L., Paillou, P., Lunine, J., Wye, L., Callahan, P., Wall, S., Elachi, C. (2010), Bathymetry and absorptivity of Titan’s Ontario Lacus. *J. Geophys. Res.*, 115:E09009,
14. Zhuravlev, K., Jackson, J., **Wolf**, A., Wicks, J., Yan, J., Clark, S. (2010), Isothermal compression behavior of (Mg,Fe)O using neon as a pressure medium. *Physics and Chemistry of Minerals*, 37:465–474,
15. Meschiari, S., **Wolf**, A. S., Rivera, E., Laughlin, G., Vogt, S., Butler, P. (2009), Systemic: A Testbed for Characterizing the Detection of Extrasolar Planets. I. The Systemic Console Package. *Publications of the Astronomical Society of the Pacific*, 121:1016–1027,
16. Ragozzine, D., **Wolf**, A. S. (2009), Probing the Interiors of very Hot Jupiters Using Transit Light Curves. *The Astrophysical Journal*, 698:1778, (**authors contributed equally**).
17. **Wolf**, A. S., Laughlin, G., Henry, G. W., Fischer, D. A., Marcy, G., Butler, P., Vogt, S. (2007), A Determination of the Spin-Orbit Alignment of the Anomalously Dense Planet Orbiting HD 149026. *The Astrophysical Journal*, 667:549,
18. Ammons, S. M., Robinson, S. E., Strader, J., Laughlin, G., Fischer, D., **Wolf**, A. (2006), The N2K Consortium. IV. New Temperatures and Metallicities for More than 100,000 FGK Dwarfs. *The Astrophysical Journal*, 638:1004,
19. Shankland, P. D., Rivera, E. J., Laughlin, G., Blank, D. L., Price, A., Gary, B., Bissinger, R., Ringwald, F., White, G., Henry, G. W., McGee, P., **Wolf**, A. S., Carter, B., Lee, S., Biggs, J., Monard, B., Ashley, M. C. B. (2006), On the Search for Transits of the Planets Orbiting Gliese 876. *The Astrophysical Journal*, 653:700,
20. Laughlin, G., Butler, R. P., Fischer, D. A., Marcy, G. W., Vogt, S. S., **Wolf**, A. S. (2005), The GJ 876 Planetary System: A Progress Report. *The Astrophysical Journal*, 622:1182,
21. Laughlin, G., **Wolf**, A., Vanmunster, T., Bodenheimer, P., Fischer, D., Marcy, G., Butler, P., Vogt, S. (2005), A Comparison of Observationally Determined Radii with Theoretical Radius Predictions for Short-Period Transiting Extrasolar Planets. *The Astrophysical Journal*, 621:1072,
22. Sato, B., Fischer, D. A., Henry, G. W., Laughlin, G., Butler, R. P., Marcy, G. W., Vogt, S. S., Bodenheimer, P., Ida, S., Toyota, E., **Wolf**, A., Valenti, J. A., Boyd, L. J., Johnson, J. A., Wright, J. T., Ammons, M., Robinson, S., Strader, J., McCarthy, C., Tah, K. L., Minniti, D. (2005), The N2K Consortium. II. A Transiting Hot Saturn around HD 149026 with a Large Dense Core. *The Astrophysical Journal*, 633:465,

## Invited Talks

- Fall AGU, Washington D.C.. December 2018.
- Fall AGU, New Orleans LA. December 2017.
- Extreme Physics and Chemistry, Deep Carbon Observatory (EPC/DCO) Meeting, Tempe AZ. November 2017.
- Lamont-Doherty Earth Observatory, Seismology, Dept. of Earth and Environmental Sciences. October 2017.
- High-Pressure Mineral Physics Seminar (HPMPS-9). September 2017.
- University of California Santa Barbara, Earth Science. September 2017.
- University of Bern, Center for Space and Habitability. August 2017.
- American Physical Society March Meeting, New Orleans LA. March 2017.
- CIDER Thermo/Fluid Dynamics Workshop, Honolulu HI. January 2017.
- High Pressure Gordon Research Seminar, Holderness NH. July 2016.
- Fall AGU, San Francisco CA. December 2015.
- Southwest Research Institute (SWRI), Boulder CO. April 2013.
- Washington University in Saint Louis - Earth and Planetary Sciences, Saint Louis MO. March 2013.
- University of Michigan - Earth and Environmental Sciences, Ann Arbor MI. March 2013.

## Courses and Workshops

- Computational thermodynamics and fluid dynamics with the ENKI software portal (Pre-Goldschmidt Workshop), Boston MA. Aug 2018 (**organizer**).
- ENKI Thermo/Fluid Dynamics User Workshop (Year 2), Santa Ana Pueblo NM. Jul 2018 (**organizer**).
- ENKI Thermodynamic Datathon Workshop, Tempe AZ. Nov 2017 (**lead organizer**).
- EPC/DCO Data Workshop, Tempe AZ. Nov 2017 (**organizer**).
- ENKI Thermo/Fluid Dynamics User Workshop (Year 1), Seattle WA. May 2017 (**organizer**).
- CIDER Thermo/Fluid Dynamics Workshop, Honolulu HI. January 2017.
- Dynamical, Dielectric and Magnetic Properties of Solids with Abinit, Lyon FR, May 2014
- Deform & COMPRES EarthCube Workshop, Washington DC, Nov 2013
- Keck Institute for Space Studies, Innovative Approaches to Planetary Seismology, Pasadena CA, March 2010
- Theoretical and Computational Methods in Mineral Physics (Pre-AGU shortcourse), San Francisco CA, December 2009
- Summer School in Statistics for Astronomers, Penn State PA, June 2009

## Community Service

- Open Source software developer for mineral physics and geological thermodynamics research (github.com/aswolf, gitlab.com/aswolf)
- Pre-Goldschmidt Workshop Organizer: Computational thermodynamics and fluid dynamics with the ENKI software portal (Boston, 2018).
- Guest Lecturer for Determinative Methods in Mineralogical Materials (UMich, 2016)
- Guest Lecturer for Atmospheric Thermodynamics (UMich, 2015, 2016)
- Guest Lecturer for Geology (Grade 1-3, Go Like the Wind Montessori School, 2016)
- Judge for the Michigan Geophysical Union (2015)
- Judge for AGU Outstanding Student Paper award (2015)
- Mentor for the Undergraduate Research Opportunity Program, UROP (2015)
- Reviewer for: NSF (Petrology & Geochemistry, Geophysics, Earthscope), Nature, Nature Scientific Reports, the American Journal of Science, the American Mineralogist, & Progress in Earth and Planetary Science

## Conference Presentations

- **Wolf**, A. S., Bower, D. J., Seclaman, A. C. (2018), Constraining the Mantle Liquidus and the impact on Magma Ocean Crystallization. *AGU Fall Meeting*, (upcoming invited talk).
- **Wolf**, A. S., Hurt, S. (2018), Anomalous structure of  $\text{MgCO}_3$  liquid and the buoyancy of carbonatite melts. *AGU Fall Meeting*, (upcoming).
- **Wolf**, A. S. (2017), Bayesian Calibration of Thermodynamic Databases and the Role of Kinetics. *AGU Fall Meeting*, (invited talk).
- **Wolf**, A. S., Bower, D. J. (2017), Modeling thermodynamics of high-pressure liquids with application to  $\text{MgSiO}_3$  for understanding magma ocean evolution. *APS March Meeting*, (invited talk).
- **Wolf**, A. S., Bower, D. J. (2017), Thermodynamic constraints on mantle melting and magma ocean crystallization. *Goldschmidt Meeting*, (poster).
- **Wolf**, A. S. (2017), The high-pressure structure of silicate melts and the impact on magma ocean evolution. *High Pressure Mineral Physics Seminar 9*, (invited talk).
- **Wolf**, A. S. (2017), Incorporating kinetics in thermodynamic model building. *Extreme Physics and Chemistry of carbon, Deep Carbon Observatory Meeting*, (invited talk).
- **Wolf**, A. S., Bower, D. J. (2016), A new thermodynamic model for high pressure melts and the impact on magma ocean crystallization. *AGU Fall Meeting*, (poster).
- **Wolf**, A. S., Dan (2016), Coordinated hard sphere mixture (chasm): Approximate modeling of oxide and silicate melts at extreme pt conditions. *High Pressure Gordon Research Seminar*, (invited talk).
- Antoshechkina, P. M., **Wolf**, A. S., Hamecher, E. A., Asimow, P. D., Ghiorso, M. S. (2015), Improved Thermodynamic Model Calibration with Bayesian Methods. (poster).
- **Wolf**, A. S., Asimow, P. D., Stevenson, D. J. (2015), Coordinated Hard Sphere Mixture (CHaSM): A fast approximate model for oxide and silicate melts at extreme conditions. *AGU Fall Meeting*, (talk).
- **Wolf**, A. S., Bower, D. J. (2015), Crystallization and Cooling of a Deep Silicate Magma Ocean. *AGU Fall Meeting*, (poster).
- **Wolf**, A. S., Asimow, P. D., Caracas, R. (2014), Cation Ordering in Fe-bearing Silicate Perovskite (Bridgmanite) and its Role in Disproportionation. *AGU Fall Meeting*, (talk).
- Antoshechkina, P. M., **Wolf**, A. S., Hamecher, E. A., Asimow, P. D., Ghiorso, M. S. (2013), Simultaneous calibration of end-member thermodynamic data and solution properties with correlated uncertainties. *AGU Fall Meeting*, (poster & presenter).
- **Wolf**, A. S., Asimow, P. D., Stevenson, D. J. (2013), Coordinated HARD Sphere Model (CHASM): A Simplified Model for Silicate and Oxide Liquids at Mantle Conditions. *AGU Fall Meeting*, (poster).
- **Wolf**, A. S., Jackson, J. M., Dera, P., Prakapenka, V. (2013), The Thermal Properties of Iron-bearing Mg-Silicate Perovskite and the Implications for Lower Mantle Structures. *COMPRES Meeting*, (talk & poster).
- **Wolf**, A. S., Jackson, J. M., Dera, P., Prakapenka, V. (2013), The Thermal Properties of Iron-bearing Mg-Silicate Perovskite and the Implications for Lower Mantle Structures. *Gordon Research Conference*, (poster).
- **Wolf**, A. S., Asimow, P. D., Stevenson, D. J. (2012), A Simplified Cation Speciation Model for Silicate Liquids at Mantle Pressures and Temperatures. *AGU Fall Meeting*, (poster).
- **Wolf**, Aaron S., Asimow, Paul D., Caracas, R. (2012), A Simplified Cation Speciation Model for Silicate Liquids at High Pressures. *Goldschmidt Meeting*, (talk).
- **Wolf**, A. S., Jackson, J. M., Dera, P. K., Prakapenka, V. (2010), Thermal Equation of State of  $(\text{Mg,Fe})\text{SiO}_3$  Perovskite in a Ne Pressure Medium. *AGU Fall Meeting Abstracts*, (poster).
- **Wolf**, A. S., Asimow, P. D., Caracas, R. (2008), Thermodynamic phase relations of the  $\text{MgO-FeO-SiO}_2$  system in the lower mantle. *Goldschmidt Conference Abstracts*, (poster).
- **Wolf**, A. S., Caracas, R., Asimow, P. D. (2008), Thermodynamic Phase Relations in the  $\text{MgO-FeO-SiO}_2$  System in the Lower Mantle. *AGU Fall Meeting Abstracts*, (talk).
- **Wolf**, A. S., Ragozzine, D. (2008), Probing the Interiors of Very Hot Jupiters Using Transit Light Curves. *Proceedings of the International Astronomical Union*, 4:163–169, (conference proceedings for talk).