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Education

Ph.D., Planetary Science and Geophysics, California Institute of Technology, 1990
Thesis: Models for the Formation of Highland Regions on Venus
M.S., Planetary Science, California Institute of Technology, 1986
B.S., Physics and Astronomy, Texas Christian University, 1984, *summa cum laude*
Honors Thesis: Fourier Transform Infrared Spectroscopy of Clay Minerals and Tar Sands

Professional Experience

Senior Staff Scientist, Lunar and Planetary Institute, 2017-
Staff Scientist, Lunar and Planetary Institute, 1993-2016
National Research Council Research Associate, Goddard Space Flight Center, 1990-1993
Graduate Research Assistant and Graduate Teaching Assistant, Division of Geological and
Planetary Sciences, California Institute of Technology, 1984-1990

Spacecraft Mission and Instrument Development Experience

Gravity Recovery and Interior Laboratory (GRAIL) mission Guest Scientist, 2012-2016
NASA Venus Landed Platform Working Group, 2018
Seismic Atmospheric Exploration of Venus (SAEVe) NASA SmallSat design study, 2017-2018
DAVINCI: Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging
mission proposal Co-I (NASA Discovery program Phase A Concept Study, 2015-16)
Venus High Temperature Seismometer Instrument Development Team, 2009-2014
NASA Venus Science and Technology Definition Team, 2008-2009
Lunar Geophysics Instrument Package Development Team, 2006-2010

Professional Activities

Member of the Focus Group for revising the “Roadmap for Venus Exploration” for NASA’s
Venus Exploration Analysis Group, 2018.
Lead convener for *Differentiation: Building the Internal Architecture of Planets*, 2018
Co-chairman, Lunar and Planetary Science Conference Program Committee, 2016-2018
Service on 20+ NASA grant proposal review panels, including 6+ times as Group Chief
Guest Associate Editor, *Meteoritics and Planetary Science*, special issue on Volatiles in the
Martian Interior (published November 2016)
Scientific Organizing Committee for *Workshop on Volatiles in the Martian Interior*, 2014
Member of the Leadership Team for revising “Goals, Objectives, and Investigations for Venus
Exploration” for NASA’s Venus Exploration Analysis Group, 2013-2014

Co-convenor of Special Session on “GRAIL Explores the Moon’s Interior”, Lunar Planetary Science Conference 44, 2013
 Science adviser for *Year of the Solar System: Digital Media for Planetary Science*, WGBH/PBS, Boston MA, 2012-2014
 Scientific Organizing Committee for *Second Conference on the Lunar Highlands Crust*, 2012
 Co-convenor of Special Session on “Interior Structure and Evolution of the Terrestrial Planets”, DI-33B and DI-43A, American Geophysical Union Fall Meeting 2010
 Scientific Organizing Committee for *Workshop on Early Planetary Differentiation: A Multi-planetary and Multi-disciplinary Perspective*, 2006
 Scientific Organizing Committee for *Conference on the Geophysical Detection of Subsurface Water on Mars*, 2001
 American Geophysical Union, Meetings Committee, 1998-2002
 American Geophysical Union, Committee on Study of the Earth's Deep Interior, 1996-1998

Publications

Science Publications (Updated June 2018)

- Nagihara, S., **W. S. Kiefer**, P. T. Taylor, D. R. Williams, and Y. Nakamura, Examination of the long-term subsurface warming observed at the Apollo 15 and 17 sites utilizing the newly restored Heat Flow Experiment data from 1975 to 1977, *J. Geophys. Res.: Planets* **123**, 1125-1139, 2018.
- Andrews-Hanna, Jeffrey C., James W. Head, Brandon Johnson, James T. Keane, **Walter S. Kiefer**, Patrick J. McGovern, Gregory A. Neumann, Mark A. Wieczorek, and Maria T. Zuber, Ring faults and ring dikes around the Orientale basin on the Moon, *Icarus* **310**, 1-20, 2018.
- Kiefer, Walter S.**, Geophysical models of the lunar interior, in *Encyclopedia of Lunar Science*, ed. Brian Cudnik, Springer International Publishing, https://doi.org/10.1007/978-3-319-05546-6_79-1 (7 pages), 2018.
- Corley, Laura M., Patrick J. McGovern, Georgiana Y. Kramer, Myriam Lemelin, David Trang, Jeffrey J. Gillis-Davis, G. Jeffrey Taylor, Kathryn E. Powell, **Walter S. Kiefer**, Mark Wieczorek, and Maria T. Zuber, Olivine-bearing lithologies on the Moon: Constraints on origins and transport mechanisms from M³ spectroscopy, radiative transfer modeling, and GRAIL crustal thickness, *Icarus* **300**, 287-304, 2018.
- Jansen, J. C., J. C. Andrews-Hanna, Y. Li, P. G. Lucey, G. J. Taylor, S. Goossens, F. G. Lemoine, E. Mazarico, J. W. Head III, C. Milbury, **W. S. Kiefer**, J. M. Soderblom, and M. T. Zuber, Small-scale density variations in the lunar crust revealed by GRAIL, *Icarus* **291**, 107-123, 2017.
- Kiefer, Walter S.**, and Qingsong Li, Water undersaturated mantle plume volcanism on present-day Mars, *Meteoritics Planet. Sci.* **51**, 1993-2010, 2016.
- Filiberto, Justin, David Baratoux, David Beaty, Doris Breuer, Benjamin J. Farcy, Matthias Grott, John H. Jones, **Walter S. Kiefer**, Prajka Mane, Francis M. McCubbin, and Susanne P. Schwenzer, A review of volatiles in the martian interior, *Meteoritics Planet. Sci.* **51**, 1935-1958, 2016.
- Zuber, Maria T., David E. Smith, Gregory A. Neumann, Sander Goossens, Jeffrey C. Andrews-Hanna, James W. Head, **Walter S. Kiefer**, Sami W. Asmar, Alexander S. Konopliv, Frank G. Lemoine, Isamu Matsuyama, H. Jay Melosh, Patrick J. McGovern, Francis Nimmo, Roger J.

- Phillips, Sean C. Solomon, G. Jeffrey Taylor, Michael M. Watkins, Mark A. Wieczorek, James G. Williams, Johanna C. Jansen, Brandon C. Johnson, James T. Keane, Erwan Mazarico, Katarina Miljković, Ryan S. Park, Jason M. Soderblom, Dah-Ning Yuan, Gravity field of the Orientale basin from the Gravity Recovery and Interior Laboratory mission, *Science* **354**, 438-441, 2016.
- Matsuyama, Isamu, Francis Nimmo, James T. Keane, Ngai H. Chan, G. Jeffrey Taylor, Mark A. Wieczorek, **Walter S. Kiefer**, and James G. Williams, GRAIL, LLR, and LOLA constraints on the interior structure of the Moon, *Geophys. Res. Lett.* **43**, 8365-8375, doi:10.1002/2016GL069952, 2016.
- Gong, Shengxia, Mark A. Wieczorek, Francis Nimmo, **Walter S. Kiefer**, James W. Head, Chengli Huang, David E. Smith, and Maria T. Zuber, Thicknesses of mare basalts on the Moon from gravity and topography, *J. Geophys. Res.: Planets* **121**, 854-870, doi:10.1002/2016JE005008, 2016.
- Sori, Michael M., Maria T. Zuber, James W. Head, and **Walter S. Kiefer**, Gravitational search for cryptovolcanism on the Moon: Evidence for large volumes of early igneous activity, *Icarus* **273**, 284-295, 2016.
- Kiefer, Walter S.**, Justin Filiberto, Constantin Sandu, and Qingsong Li, The effects of mantle composition on the peridotite solidus: Implications for the magmatic history of Mars, *Geochim. Cosmochim. Acta* **162**, 247-258, 2015.
- Lillis, Robert J., Josef Dufek, **Walter S. Kiefer**, Benjamin A. Black, Michael Manga, Jacob A. Richardson, and Jacob E. Bleacher, The Syrtis Major volcano, Mars: A multidisciplinary approach to interpreting its magmatic evolution and structural development, *J. Geophys. Res.: Planets* **120**, 1476-1496, doi:10.1002/2014JE004774, 2015.
- Neumann, Gregory A., Maria T. Zuber, Mark A. Wieczorek, James W. Head, David M. H. Baker, Sean C. Solomon, David E. Smith, Frank G. Lemoine, Erwan Mazarico, Terence J. Sabaka, Sander J. Goossens, H. Jay Melosh, Roger J. Phillips, Sami W. Asmar, Alexander S. Konopliv, James G. Williams, Michael M. Sori, Jason M. Soderblom, Katarina Miljković, Jeffrey C. Andrews-Hanna, Francis Nimmo, and **Walter S. Kiefer**, Lunar impact basins revealed by Gravity Recovery and Interior Laboratory measurements, *Science Advances* **1**, e1500852, 2015 (10 pages).
- Jawin, Erica R., **Walter S. Kiefer**, Caleb I. Fassett, D. Benjamin J. Bussey, Joshua T.S. Cahill, M. Darby Dyar, Samuel J. Lawrence, and Paul D. Spudis, The relationship between radar scattering and surface roughness of lunar volcanic features, *J. Geophys. Res.: Planets* **119**, 2331-2348, doi:10.1002/2014JE004668, 2014.
- Andrews-Hanna, Jeffrey C., Jonathan Besserer, James W. Head III, Carly J. A. Howett, **Walter S. Kiefer**, Paul J. Lucey, Patrick J. McGovern, H. Jay Melosh, Gregory A. Neumann, Roger J. Phillips, Paul M. Schenk, David E. Smith, Sean C. Solomon, and Maria T. Zuber, Structure and evolution of the lunar Procellarum region as revealed by GRAIL gravity data, *Nature* **514**, 68-71, 2014.
- Williams, James G., Alexander S. Konopliv, Dale H. Boggs, Ryan S. Park, Dah-Ning Yuan, Frank G. Lemoine, Sander Goossens, Erwan Mazarico, Francis Nimmo, Renee C. Weber, Sami W. Asmar, H. Jay Melosh, Gregory A. Neumann, Roger J. Phillips, David E. Smith, Sean C. Solomon, Michael M. Watkins, Mark A. Wieczorek, Jeffrey C. Andrews-Hanna, James W. Head, **Walter S. Kiefer**, Isamu Matsuyama, Patrick J. McGovern, G. Jeffrey Taylor, and Maria T. Zuber, Lunar interior properties from the GRAIL mission, *J. Geophys. Res.: Planets* **119**, 1546-1578, doi:10.1002/2013JE004559, 2014.

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- Kiefer, Walter S.**, Gravity constraints on the subsurface structure of the Marius Hills: The magmatic plumbing of the largest lunar dome complex, *J. Geophys. Res.: Planets* **118**, 733-745, doi:10.1029/2012JE004111, 2013.
- Potter, Ross W.K., David A. Kring, Gareth S. Collins, **Walter S. Kiefer**, and Patrick J. McGovern, Numerical modeling of the formation and structure of the Orientale impact basin, *J. Geophys. Res.: Planets* **118**, 963-979, doi:10.1002/jgre.20080, 2013.
- Spudis, Paul D., Patrick J. McGovern, and **Walter S. Kiefer**, Large shield volcanoes on the Moon, *J. Geophys. Res.: Planets* **118**, 1063-1081, doi:10.1002/jgre.20059, 2013.
- Wieczorek, Mark A., Gregory A. Neumann, Francis Nimmo, **Walter S. Kiefer**, G. Jeffrey Taylor, H. Jay Melosh, Roger J. Phillips, Sean C. Solomon, Jeffrey C. Andrews-Hanna, Sami W. Asmar, Alexander S. Konopliv, Frank G. Lemoine, David E. Smith, Michael M. Watkins, James G. Williams, and Maria T. Zuber, The crust of the Moon as seen by GRAIL, *Science* **339**, 671-675, 2013.
- Andrews-Hanna, Jeffrey C., Sami W. Asmar, James W. Head III, **Walter S. Kiefer**, Alexander S. Konopliv, Frank G. Lemoine, Isamu Matsuyama, Erwan Mazarico, Patrick J. McGovern, H. Jay Melosh, Gregory A. Neumann, Francis Nimmo, Roger J. Phillips, David E. Smith, Sean C. Solomon, G. Jeffrey Taylor, Mark A. Wieczorek, James G. Williams, and Maria T. Zuber, Ancient igneous intrusions and early expansion of the Moon revealed by GRAIL gravity gradiometry, *Science* **339**, 675-678, 2013.
- Kiefer, Walter S.**, Robert J. Macke, Daniel T. Britt, Anthony J. Irving, and Guy J. Consolmagno, The density and porosity of lunar rocks, *Geophys. Res. Lett.* **39**, L07201, doi:10.1029/2012GL051319, 2012 (5 pages).
- Kiefer, Walter S.**, Lunar heat flow experiments: Science objectives and a strategy for minimizing the effects of lander-induced perturbations, *Planet. Space Sci.* **60**, 155-165, 2012.
- Sandu, Constantin, and **Walter S. Kiefer**, Degassing history of Mars and the lifespan of its magnetic dynamo, *Geophys. Res. Lett.* **39**, L03201, doi:10.1029/2011GL050225, 2012 (5 pages).
- Potter, Ross W.K., Gareth S. Collins, **Walter S. Kiefer**, Patrick J. McGovern, and David A. Kring, Constraining the size of the South Pole-Aitken basin impact, *Icarus* **220**, 730-743, 2012.
- Potter, Ross W.K., David A. Kring, Gareth S. Collins, **Walter S. Kiefer**, and Patrick J. McGovern, Estimating transient crater size using the crustal annular bulge: Insights from numerical modeling of lunar basin-scale impacts, *Geophys. Res. Lett.* **39**, L18203, doi:10.1029/2012GL052981, 2012 (5 pages).
- Filiberto, Justin, Rajdeep Dasgupta, **Walter S. Kiefer**, and Allan H. Treiman, High pressure, near-liquidus phase equilibria of the Home Plate basalt Fastball and melting in the Martian mantle, *Geophys. Res. Lett.* **37**, L13201, doi:10.1029/2010GL043999, 2010 (4 pages).
- Kiefer, Walter S.**, and Qingsong Li, Mantle convection controls the observed lateral variations in lithospheric thickness on present-day Mars, *Geophys. Res. Lett.* **36**, L18203, doi:10.1029/2009GL039827, 2009 (5 pages).

- Li, Qingsong, and **Walter S. Kiefer**, Mantle convection and magma production on present-day Mars: Effects of temperature-dependent rheology, *Geophys. Res. Lett.* **34**, L16203, doi:10.1029/2007GL030544, 2007 (5 pages).
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- Kiefer, Walter S.**, and Laura C. Swafford, Topographic analysis of Devana Chasma, Venus: Implications for rift system segmentation and propagation, *J. Struc. Geol.* **28**, 2144-2155, 2006.
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- Kiefer, Walter S.**, Buried mass anomalies along the hemispheric dichotomy in eastern Mars: Implications for the origin and evolution of the dichotomy, *Geophys. Res. Lett.* **32**, L22201, doi:10.1029/2005GL024260, 2005 (4 pages).
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- Kiefer, Walter S.**, Melting in the Martian mantle: Shergottite formation and implications for present-day mantle convection on Mars, *Meteoritics Planet. Sci.* **38**, 1815-1832, 2003.
- Kiefer, Walter S.**, and Kelly Peterson, Mantle and crustal structure in Phoebe Regio and Devana Chasma, Venus, *Geophys. Res. Lett.* **30** (1), article 1005, doi:10.1029/2002GL015762, 2003 (4 pages).
- Kiefer, Walter S.**, and Louise H. Kellogg, Geoid anomalies and dynamic topography from time-dependent, spherical axisymmetric mantle convection, *Physics of the Earth and Planetary Interiors* **106**, 237-256, 1998.
- Smrekar, Suzanne E., **Walter S. Kiefer**, and Ellen R. Stofan, Large volcanic rises on Venus, in *Venus II: Geology, Geophysics, Atmosphere, and Solar Wind Environment*, edited by S.W. Bougher, D.M. Hunten, and R.J. Phillips, University of Arizona Press, 845-878, 1997.
- Kiefer, Walter S.**, Bruce G. Bills, and R. Steven Nerem, An inversion of gravity and topography for mantle and crustal structure on Mars, *J. Geophys. Res.* **101**, 9239-9252, 1996.
- Kiefer, Walter S.**, Mantle viscosity stratification and flow geometry: Implications for surface motions on Earth and Venus, *Geophys. Res. Lett.* **20**, 265-268, 1993.
- Kiefer, Walter S.**, and Bradford H. Hager, Geoid anomalies and dynamic topography from convection in cylindrical geometry: Applications to mantle plumes on Earth and Venus, *Geophysical Journal International* **108**, 198-214, 1992.
- Kiefer, Walter S.**, and Bradford H. Hager, A mantle plume model for the Equatorial Highlands of Venus, *J. Geophys. Res.* **96**, 20,947-20,966, 1991.
- Kiefer, Walter S.**, and Bradford H. Hager, Mantle downwelling and crustal convergence: A model for Ishtar Terra, Venus, *J. Geophys. Res.* **96**, 20,967-20,980, 1991.
- Kiefer, Walter S.**, A reexamination of the spreading center hypothesis for Ovda and Thetis Regiones, Venus, *Geophys. Res. Lett.* **17**, 1373-1376, 1990.
- Bills, Bruce G., **Walter S. Kiefer**, and Robert L. Jones, Venus gravity: A harmonic analysis, *J. Geophys. Res.* **92**, 10,335-10,351, 1987.
- Kiefer, Walter S.**, and Bruce C. Murray, The formation of Mercury's smooth plains, *Icarus* **72**, 477-491, 1987.

Shepherd, Robert A., **Walter S. Kiefer**, and W.R.M. Graham, Characterization of the Circle Cliffs Tar Sands: 1. Application of the FTIR technique to mineral matter, *Fuel* **65**, 1261-1264, 1986.

Kiefer, Walter S., Mark A. Richards, Bradford H. Hager, and Bruce G. Bills, A dynamic model of Venus's gravity field, *Geophys. Res. Lett.* **13**, 14-17, 1986.

Walker, David, and **Walter S. Kiefer**, Xenolith digestion in large magma bodies, *Proc. Lunar and Planetary Sci. Conf. 15, J. Geophys. Res. (supplement)* **90**, C585-C590, 1985.

Instrument Design and Mission Planning Documents

Stevenson, David, James Cutts, David Mimoun, Stephen Arrowsmith, Bruce Banerdt, Philip Blom, Emily Brageot, Quentin Brissaud, Gordon Chin, Peter Gao, Raphael Garcia, Jeffery Hall, Gary Hunter, Jennifer Jackson, Viktor Kerzhanovich, **Walter Kiefer**, Attila Komjathy, Christopher Lee, Phillipe Lognonné, Ralph Lorenz, Walid Majid, Mohammed Mojarradi, Guust Nolet, Joseph O'Rourke, Lucie Rolland, Gerald Schubert, Mark Simons, Christophe Sotin, Tom Spilker, and Victor Tsai, *Probing the Interior Structure of Venus*, Keck Institute of Space Studies, California Institute of Technology, 85 pages, 2015.

Herrick, Robert, Kevin Baines, Mark Bullock, Gordon Chin, Bob Grimm, **Walter Kiefer**, Steve Mackwell, Kevin McGouldrick, Buck Sharpton, Sue Smrekar, and Constantine Tsang, *Goals, Objectives, and Investigations for Venus Exploration*, NASA Venus Exploration Analysis Group, 15 pages, 2014.

Ponchak, George E., Maximillian C. Scardelletti, Brandt Taylor, Steve Beard, Roger D. Meredith, Glenn M. Beheim, Gary W. Hunter, and **Walter S. Kiefer**, High temperature, wireless seismometer sensor for Venus, *RWW 2012 – Proceedings of the 2012 IEEE Topical Conference on Wireless Sensors and Sensor Networks*, article number 6172141, pp. 9-12, 2012.

Bullock, Mark, David Senske, Tibor Balint, Alexis Benz, Bruce Campbell, Eric Chassefiere, Anthony Colaprete, Jim Cutts, Lori Glaze, Steve Gorevan, David Grinspoon, Jeffrey Hall, George Hashimoto, Jim Head, Gary Hunter, Natasha Johnson, Victor Kerzhanovich, **Walter S. Kiefer**, Elizabeth Kowala, Tibor Kremic, Sanjay Limaye, Steve Mackwell, Mikhail Marov, Adriana Ocampo, Craig Peterson, Gerald Schubert, Ellen Stofan, Hakam Svedhem, Dimitri Titov, and Allan Treiman (Venus Science and Technology Definition Team), *Venus Flagship Mission Study*, NASA Jet Propulsion Laboratory, 282 pages, 2009.

Commentary and Meeting Reports

Kiefer, Walter S., The influence of crustal radioactivity on mantle convection and lithospheric thickness on Mars, *J. Geophys. Res.: Planets* **121**, 2463-2466, 2016.

Filiberto, Justin, David Beaty, and **Walter Kiefer**, Volatiles in Mars: Constraints, questions, and future directions, *Eos Earth and Space News* **96** (8), 10, 2015.

Kiefer, Walter S., Forming the Martian great divide, *Nature* **453**, 1191-1192, 2008.

Kiefer, Walter S., Venus after Magellan: Where do we go from here?, *Lunar and Planetary Information Bulletin* **74**, 2-4, Winter 1995.

Education Publications

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- Shipp, Stephanie, Christine Shupala, Allan Treiman, David Kring, and **Walter Kiefer**, “How Did Our Moon Form?”, “Our Moon in a New Light”, and “To the Moon and Beyond”, www.lpi.usra.edu/education/moon_poster.shtml, 3 poster set for grades 6-9, 2009.
- Nelson, Becky, Katy Buckaloo, Stephanie Shipp, **Walter S. Kiefer**, and Tomasz Stepinski, Exploring Mars: Inside and Out!, www.lpi.usra.edu/education/explore/mars/, 150 pages, 2007.
- Kiefer, Walter S.**, Robert R. Herrick, Allan H. Treiman, and Pamela B. Thompson, Exploring the Solar System: A science enrichment course for gifted elementary school students, pp. 130-132 in *Proceedings of the NASA Office of Space Science Education and Public Outreach Conference*, eds. C. Narasimhan, B. Beck-Winchatz, I. Hawkins, and C. Runyon, Astronomical Society of the Pacific Conference Series Vol. 319, 2004.
- Kiefer, Walter S.**, and Kin Leung, Image processing experiments for the classroom, pp. 318-320 in *Proceedings of the NASA Office of Space Science Education and Public Outreach Conference*, eds. C. Narasimhan, B. Beck-Winchatz, I. Hawkins, and C. Runyon, Astronomical Society of the Pacific Conference Series Vol. 319, 2004.
- Treiman, Allan, and **Walter Kiefer**, *Exploring Mars Educational Brief*, NASA Publication EB-2003-06-120-HQ (8 pages), 2003.
- Kiefer, Walter S.**, Europa and Titan: Oceans in the outer Solar System?, *Space Science Reference Guide, 2nd Edition*, CD-ROM, Lunar and Planetary Institute, 2003.
- Kiefer, Walter S.**, Impact craters in the Solar System, *Space Science Reference Guide, 2nd Edition*, CD-ROM, Lunar and Planetary Institute, 2003.
- Kiefer, Walter S.**, Allan H. Treiman, and Stephen M. Clifford, *The Red Planet: A Survey of Mars* (40 slides and 26 page caption book), Lunar and Planetary Institute, Houston. First Edition, 1995; Second Edition, 1997.
(www.lpi.usra.edu/publications/slidesets/redplanet2/index.shtml)