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2. Home Address:

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3. Education:

- Ph.D., Massachusetts Institute of Technology, Planetary Science, 1977
- M.S., Massachusetts Institute of Technology, Planetary Science, 1972
- B.S., Massachusetts Institute of Technology, Planetary Science, 1971
- B.A., Antioch College, Math-Education, 1966

4. Professional Positions:

1994 to Present	Professor, Department of Geological Sciences (name changed to DEEPS in 2014), Brown University.
1983-1994	Associate Professor, Department of Geological Sciences, Brown University Providence, Rhode Island.
1980-1983	Assistant Professor of Research, Department of Geological Sciences, Brown University, Providence, Rhode Island.
1977-1980	Space Scientist, Lunar and Planetary Sciences Division, NASA Johnson Space Center, Houston, Texas.
1972-1975	Division of Sponsored Research Staff Scientist, Massachusetts Institute of Technology, Planetary Astronomy Laboratory, Department of Earth and Planetary Sciences.
1967-1969	Science teacher (Peace Corps), Sarawak, Malaysia.
1966-1967	High School. Math teacher, Somerville, Massachusetts.

5. Completed Research:

Publications: More than 250 research articles in peer-reviewed scientific journals, including a book *Remote Geochemical Analyses* (Cambridge University Press). In addition, each year tens of short and extended abstracts are presented at professional meetings and workshops See attached for the last several years of peer-reviewed publications. Full publication list can be found at: [http://www.planetary.brown.edu/html\\_pages/pieters\\_refpubs\\_date.htm](http://www.planetary.brown.edu/html_pages/pieters_refpubs_date.htm)

6. Research in Progress:

- PI, Moon Mineralogy Mapper (M3): Principal Investigator for an imaging spectrometer (0.4-3.0  $\mu\text{m}$ ) to characterize and map the mineralogy of the Moon at high resolution. M3 was launched on the Indian Chandrayaan-1 spacecraft to the Moon in October 2008 and acquired compositional data until September 2009. The data continually produce high quality science.
- PI, NASA Solar System Exploration Research Virtual Institute (SSERVI) at Brown University. Responsible for leading a 'virtual' institute involving 24 CoI's and 19 Collaborators focused on exploration and science issues for the Moon, asteroids and moons of Mars.

- Laboratory spectroscopy experiments: Measuring and modeling the interaction of visible to mid-infrared radiation with geologic materials. Development of quantitative methods for extraction of compositional information. Includes extensive measurement and analyses of lunar samples and meteorites as well as terrestrial analogue materials.
- Lunar science: Remote compositional analysis using spectroscopic data. Science questions focus on formation and evolution of the lunar crust and character and diversity of mare basalt types. Craters and large basins are used as probes to the interior.
- Space weathering: Characterize and understand the processes responsible for altering materials in the space environment and measure the effects of these processes on geologic samples. Compositional applications for Mercury, the Moon, asteroids, Phobos/Deimos.
- Dawn Science Team. Participation in the mission to study the large asteroids Vesta and Ceres in detail. Principal responsibilities include oversight and integration of remote compositional measurements and development of links to meteorites and understanding of early solar system processes. Launched in 2007; arrives at Vesta in 2011 and Ceres in 2015.
- Asteroid - meteorite links: Evaluate observational, laboratory, and experimental data to identify asteroidal source bodies for diverse meteorite types. Science focus is on evolution of the early solar system.
- International collaboration: Promoting and assisting in planning international exploration with Germany, England, Japan, Russia, India, China, and Korea. Participate in integrated science and mission discussions.

*Recent Mission Involvement:*

*Chandrayaan-1* (a mission to the Moon launched by the Indian Space Research Organization in October 2008). I am Principal Investigator of a US guest instrument, the Moon Mineralogy Mapper (M3), selected by NASA's Discovery Program after an intense peer-review process. I have overall responsibility for the success of this instrument and M3 Science Team activities. M3 was built by the Jet Propulsion Laboratory.

*Dawn* (a Discovery mission launched in 2007) Co-Investigator. Participation in planning the mission to study the large asteroids Vesta and Ceres in detail. Principal responsibilities include oversight and integration of remote compositional measurements and development of links to meteorites and understanding of early solar system processes. Dawn arrives at Vesta mid-2011 and Ceres in 2015, and remain in orbit ~1 year.

*MoonRise* (a New Frontiers mission to return samples from the lunar South Pole-Aitken Basin under preparation) Co-Investigator. Principal responsibilities are in site selection and initial analysis of returned soils for remote sensing compositional links.

*Research Grant Awards* (active over last 10 years):

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| 5/85-2012  | " <i>Reflectance Experiment Laboratory (RELAB)</i> " (NAG5-13609; NNG06GJ31G); C. Pieters, PI, NASA Solar System Exploration   |
| 1/03-2016  | <i>Dawn</i> [a Discovery Mission, C. Russell, PI] (2090 G DC288); C. Pieters CoI, JPL/NASA Discovery Program   |
| 3/05-12/11 | <i>Moon Mineralogy Mapper</i> , (NNM05AB26C); C. Pieters, PI, NASA Discovery Program   |
| 4/05-3/09  | " <i>Mineralogy of Lunar Materials from Reflectance Spectroscopy II: Rocks and Minerals</i> " (NNG05GG15G); C. Pieters, PI, NASA Solar System Exploration, CosmoChem |

- 8/07 – 8/10 “*Characterizing the rocks of Mars through integrated spectroscopy*” (NNX07AR66G); C. Pieters, PI, Mars Fundamental Research Program, NASA Solar System Research
- 7/07-7/10 “Integrated spectroscopy of synthetic pyroxenes: Tools to characterize igneous processes on the inner planets” (NNX07AP41G) NASA Solar System Exploration, Planetary Geology and Geophysics [Lead by R. Klima]
- 2008-2011 “Spectroscopy of Lunar Meteorites: Groundwork for lunar exploration”, NASA Lunar Advanced Science and Exploration Research: LASER [Lead by P. Isaacson]
- 2009-2013 “*The Moon as Cornerstone to the Terrestrial Planets: The Formative Years*” NASA Lunar Science Institute, C. Pieters, PI
- 2012 – 2016 “*Evolution and Mineral Composition of the Lunar Crust Science*”, C. Pieters, PI, NASA Lunar Advanced Science and Exploration Research: LASER
- 2014 – 2018 “*SSERVI Evolution and Environment of Exploration Destinations*” C. Pieters, PI, NASA Solar System Exploration Research Virtual Institute.

## 7. Service:

### *Recent Service to the University:*

- Research Advisory Board, Office of the Vice President of Research, 2009-2012.
- University committee: Tenure, Promotion and Appointments Committee (TPAC) 2007 – 2009
- Lecturer for Alumni and Development

### *Current and Recent Service to the Profession:*

- Member (and Vice-Chair), NASA Advisory Council Science Committee 2013 – present
- Member, OSIRIS-Rex Standing Review Board 2013 – present
- Chair, AGU Fellows Committee 2013-2014
- Member, AGU Honors and Recognition committee 2010-2014
- Member, Planetary Protection Subcommittee, a NASA sponsored committee to advise the Planetary Protection Officer on forward and back contamination issues. [2002 to present, although the name changes]
- Member, AGU Flinn award committee (2006-2010)
- Member, AGU Planetary Sciences section Awards Committee, 2009-2010.
- Chair, Awards Committee, AGU, Planetary Sciences Section (2006 to 2009)
- Chair, MoonLITE Science Evaluation Board, NASA-UK (2008)
- Co-Chair, National Academies, NRC Space Studies Board, Committee on Scientific Context for Exploration of the Moon (2006-2007)
- Member, AGU Fellows Committee [2001 to 2006]
- Science Manager, NASA/Keck Reflectance Experiment Laboratory (RELAB) [current]
- Associate Editor, *Meteoritics and Planetary Sciences*, 1998-present
- Member, Visiting Committee, MIT Department of Earth, Atmosphere, and Planetary Sciences [2000-2008]
- President, ILEWG (International Lunar Exploration Working Group) [2002-2004]
- Chair, Solar System Exploration Survey, Inner Planets Panel, NAS/NRC [2001/2]

- Member, Advisory Committee on Hall of Meteorites, American Museum of Natural History, NYC [2001/2]
- Past President, Planetary Sciences Section, American Geophysical Union, 1998 - 2000

## 8. Honors and Awards

### *Recent Honors*

- International Cooperation Medal, Committee on Space Research (COSPAR)
- GSA Fellow 2011
- Shoemaker Lecturer, AGU 2010 Fall Meeting
- GSA G. K. Gilbert Award, 2010.
- NASA Exceptional Scientific Achievement Medal 2010
- Elected Fellow of American Association for the Advancement of Science (2007)
- Elected member of International Academy of Astronautics (2006)
- Gerard P. Kuiper Prize, American Astronomical Society, Division for Planetary Sciences, 2004
- Elected President, ILEWG (International Lunar Exploration Working Group) 2002-2004
- Elected Chair, American Association Advancement of Science, Astronomy Section 2002/3
- Elected Fellow, American Geophysical Union, 2001

## 9. Teaching:

### Graduate Students directly supervised 2007-2015:

Noah Petro: PhD completed 2007; completion of Master of Science Thesis 2003; studies in remote sensing and lunar evolution. Currently working at NASA Goddard Space Flight Center (MD)

Rachel Klima; PhD completed 2008; studies included work on laboratory studies of lunar, Martian, and terrestrial materials; has become a world expert on NIR spectroscopy of pyroxenes.; worked at Brown as a post-doctoral Research Associate and was then hired at Applied Physics Laboratory/Johns Hopkins University.

Peter Isaacson: PhD thesis completed 2010; involved with remote compositional analysis; very active in M3 and working with lunar samples in the laboratory; focus on the Mg-suite of lunar rocks. Served as a postdoc at Brown until December 2011; Accepted a position at Univ. Hawaii.

Leah Cheek: Completed PhD 2013; Led two projects, one an experimental approach to characterize properties of Fe-bearing anorthositic plagioclase, the other on remote analysis of lunar anorthosites. Currently a PostDoc at Boston University.

Kerri Donaldson Hanna: Completed PhD 2013; Deeply involved in research using laboratory emission spectra from the new ALEC as well as applied remote sensing for lunar science. A member of DIVINER team for LRO. Currently a PostDoc at Oxford, UK.

Deepak Dhingra: completed PhD 2014; completed a project on Mg-spinel at Theophilus crater. Currently a PostDoc at Univ. Idaho.

Daniel Morarity: Completed Master of Science degree in 2012; working on projects in remote compositional analyses and laboratory experiments

## 10. Prepared: March 2015

## Carle M. Pieters

Publications in peer-reviewed journals, articles, or books, 2007 to 2014.

For full list of publications:

[http://www.planetary.brown.edu/html\\_pages/pieters\\_refpubs\\_date.htm](http://www.planetary.brown.edu/html_pages/pieters_refpubs_date.htm)

### 2007

- Dyar, M. D., R. L. Klima, D. Lindsley, and C. M. Pieters (2007), Effects of differential recoil-free fraction on ordering and site occupancies in Mössbauer spectroscopy of orthopyroxenes, *American Mineralogist*, *92*, 424-428, doi: 10.2138/am.2007.2441.
- Klima, R. L., C. M. Pieters, and M. D. Dyar (2007), Spectroscopy of synthetic Mg-Fe pyroxenes I: Spin-allowed and spin-forbidden crystal field bands in the visible and near-infrared, *Meteor. Planet. Sci.*, *42*, 235-253.
- Noble, S. K., C. M. Pieters, and L. P. Keller (2007), An experimental approach to understanding the optical effects of space weathering, *Icarus*, *192*, 629-642, doi: 10.1016/j.icarus.2007.07.021.
- Pieters, C.M. et al., Lunar international science coordination/calibration targets (L-ISCT), *J. Adv. Space Res.* (2007), doi:10.1016/j.asr.2007.05.038
- Robinson, M. S., B. W. Hapke, J. B. Garvin, D. Skillman, J. F. Bell III, M. P. Ulmer, and C. M. Pieters (2007), High resolution mapping of TiO<sub>2</sub> abundances on the Moon using the Hubble Space Telescope, *Geophys. Res. Lett.*, *34*, L13203, doi: 10.1029/2007GL029754.
- Treiman, A. H., M. D. Dyar, M. C. McCanta, S. K. Noble, and C. M. Pieters (2007), Martian Dunitite NWA 2737: Petrographic constraints on geological history, shock events, and olivine color, *J. Geophys. Res.*, *112*, E04002, doi: 10.1029/2006JE002777.

### 2008

- Haruyama, Junichi, Makiko Ohtake, Tsuneo Matsunaga, Tomokatsu Morota, Chikatoshi Honda, Yasuhiro Yokota, Carle M. Pieters, Seiichi Hara, Kazuyuki Hioki, Kazuto Saiki, Hideaki Miyamoto, Akira Iwasaki, Masanao Abe, Yoshiko Ogawa, Hiroshi Takeda, Motomaro Shirao, Atsushi Yamaji, Jean-Luc Josset (2008a) Lack of Exposed Ice Inside Lunar South Pole Shackleton Crater, *Science*, Volume 322, Issue 5903, pp. 938- [Published online 23 October 2008; 10.1126/science.1164020]; *Science*, *322*, 938-939, doi:10.1126/science.1164020
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- Klima, RL, CM Pieters, and MD Dyar (2008) Characterization of the 1.2  $\mu$ m M1 pyroxene band: Extracting cooling history from near-IR spectra of pyroxenes and pyroxene-dominated rocks, *Meteoritics and Planetary Science*. vol 43, 1591-1604
- Nimura, T., T. Hiroi, and C. M. Pieters (2008), An improved scheme for modeling the reflectance spectra of space-weathered regoliths, *Earth Planets Space*, *60*, 271-275.
- Petro, N. E. and Pieters, C. M. (2008) The Lunar-Wide Effects of Basin Ejecta Distribution on the Early Megaregolith, *Meteoritics and Planetary Science*, v. 43(8), p. 1517-1529.
- Pieters C.M., R. L. Klima, T. Hiroi, M. D. Dyar, M. D. Lane, A. H. Treiman, S. K. Noble, J. M.

Sunshine, and J. L. Bishop. (2008) Martian Dunite NWA 2737: Integrated Spectroscopic Analyses of Brown Olivine, *J. Geophys. Res.* 113, E06004, doi: 10.1029/2007JE002939.

## 2009

- Crawford, I. A., K. H. Joy, B. J. Kellett, M. Grande, M. Anand, N. Bhandari, A. C. Cook, L. d'Uston, V. A. Fernandes, O. Gasnault, J. N. Goswami, C. J. Howe, J. Huovelin, D. Koschny, D. J. Lawrence, B. J. Maddison, S. Maurice, S. Narendranath, C. M. Pieters, T. Okada, D. A. Rothery, S. S. Russell, P. Sreekumar, B. Swinyard, M. A. Wieczorek, and M. Wilding (2009), The scientific rationale for the C1XS X-ray spectrometer on India's Chandrayaan-1 mission to the moon, *Planet. Space Sci.*, 57, 725-734, doi:10.1016/j.pss.2008.12.006.
- Dyar, MD., E.C. Sklute, O.N. Menzies, P.A. Bland, D. Lindsley, T. Glotch, M.D. Lane, M.W. Schaeffer, B. Wopenka, R. Klima, J.L. Bishop, T. Hiroi, C. Pieters, and J. Sunshine Spectroscopic Characteristics of Synthetic Olivine: An Integrated Multi-Wavelength and Multi-Technique Approach (2009)*American Mineralogist*, Volume 94, pages 883–898
- Grande, M., B. J. Maddison, C. J. Howe, B. J. Kellett, P. Sreekumar, J. Huovelin, I. A. Crawford, C. L. Duston, D. Smith, M. Anand, N. Bhandari, A. Cook, V. Fernandes, B. H. Foing, O. Gasnault, J. N. Goswami, A. Holland, K. H. Joy, D. Kochney, D. Lawrence, S. Maurice, T. Okada, S. Narendranath, C. M. Pieters, D. A. Rothery, S. S. Russell, A. Shrivastava, B. Swinyard, M. Wilding, and M. A. Wieczorek (2009), The C1XS X-ray spectrometer on Chandrayaan-1, *Planet. Space Sci.*, 57, 717-724, doi: 10.1016/j.pss.2009.01.016.
- Haruyama, J., K. Hioki, M. Shirao, T. Morota, H. Hiesinger, C van der Bogert, H. Miyamoto, A. Iwasaki, Y. Yokota, M. Ohtake, T. Matsunaga, S. Hara, S. Nakanotani, C. Pieters . (2009), Possible lunar lava tube skylight observed by SELENE cameras, *Geophys. Res. Lett.*, 36, L21206, doi:10.1029/2009GL040635.
- Isaacson, P. J., and C. M. Pieters (2009), Northern Imbrium Noritic anomaly, *J. Geophys. Res.*, 114, E09007, doi:10.1029/2008JE003293.
- Ohtake, M., T. Matusanaga, J. Haruyama, Y. Yokota, T. Morota, C. Honda, Y. Ogawa, M. Torii, H. Miyamoto, T. Arai, N. Hirata, A. Iwasaki, R. Nakamura, T. Hiroi, T. Sugihara, H. Takeda, H. Otake, C. Pieters, K. Saiki, K. Kitazato, M. Abe, N. Asada, H. Demura, Y. Yamaguchi, S. Sasaki, S. Kodama, J. Terazono, M. Shirao, A. Yamaji, S. Minami, H. Akiyama, J-L Josset, (2009) The global distribution of pure anorthosite on the Moon, *Nature* 461, 236-240, | doi:10.1038/nature08317
- Moroz, L. V., A. T. Basilevsky, T. Hiroi, S. S. Rout, D. Baither, C. H. van der Bogert, O. I. Yakovlev, A. V. Fisenko, L. F. Semjonova, V. S. Rusakov, D. A. Khramov, N. G. Zinovieva, G. Arnold, and C. M. Pieters (2009), Spectral properties of simulated impact glasses produced from martian soil analogue JSC Mars-1, *Icarus*, 202, 336-353, doi:10.1016/j.icarus.2009.02.007.
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- Pieters, C., M., J. N. Goswami, R. N. Clark, M. Annadurai, J. Boardman, B. Buratti, J.-P. Combe, M. D. Dyar, R. Green, J. W. Head, C. Hibbitts, M. Hicks, P. Isaacson, R. Klima, G. Kramer, S. Kumar, E. Livo, S. Lundeen, E. Malaret, T. McCord, J. Mustard, J. Nettles, N. Petro, C. Runyon, M. Staid, J. Sunshine, L. A. Taylor, S. Tompkins, P. Varanasi, (2009) Character and Spatial Distribution of OH/H<sub>2</sub>O on the Surface of the

Moon Seen by M3 on Chandrayaan-1, *Science* 23, DOI: 10.1126/science.1178658, 568-572.

## 2010

- Isaacson, P. J., and C. M. Pieters (2010), Deconvolution of lunar olivine reflectance spectra: Implications for remote compositional assessment, *Icarus*, 210, 8-13, doi: 10.1016/j.icarus.2010.06.004.
- Korokhin, V. V., Y. I. Velikodsky, Y. G. Shkuratov, V. G. Kaydash, S. Y. Gerasimenko, N. V. Opanasenko, G. Videen, and C. M. Pieters (2010), Removal of topographic effects from lunar images using Kaguya (LALT) and Earth-based observations, *Planet. Space Sci.*, 58, 1298-1306, doi: 10.1016/j.pss.2010.05.013.
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## 2011

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- Cheek, L. C., C. M. Pieters, J. W. Boardman, R. N. Clark, J.-P. Combe, J. W. Head, P. J. Isaacson, T. B. McCord, D. Moriarty, J. W. Nettles, N. E. Petro, J. M. Sunshine, and L. A. Taylor (2011), Goldschmidt crater and the Moon's north polar region: Results from the Moon Mineralogy Mapper (M-3), *J. Geophys. Res.*, 116, E00G02, doi: 10.1029/2010je003702.
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- Green, R. O., C. M. M. Pieters, P. Mouroulis, M. Eastwood, J. W. Boardman, T. Glavich, P. Isaacson, M. Annadurai, S. Besse, D. C. Barr, B. J. Buratti, D. Cate, A. Chatterjee, R. N. Clark, L. C. Cheek, J.-P. Combe, D. Dhingra, V. Essandoh, S. Geier, J. N. Goswami, R. Green, V. Haemmerle, J. W. Head, L. Hovland, S. Hyman, R. L. P. Klima, T. Koch, G. Y. Kramer, A. S. K. Kumar, K. Lee, S. Lundeen, E. Malaret, T. B. McCord, S. McLaughlin, J. F. Mustard, J. W. W. Nettles, N. Petro, K. S. Plourde, C. S. Racho, J. I. Rodriguez, C. Runyon, R. G. Sellar, C. Smith, H. R. Sobel, M. Staid, J. M. Sunshine, L. A. A. Taylor, K. G. Thaisen, S. Tompkins, H. Tseng, G. Vane, P. Varanasi, M. L. White, and D. W. Wilson (2011) The Moon Mineralogy Mapper (M3) Imaging Spectrometer for Lunar Science: Instrument Description, Calibration, On-Orbit Measurements, Science Data Calibration and On-Orbit Validation, *J. Geophys. Res.*, 116, E00G19, doi:10.1029/2011JE003797
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- Isaacson, P. J., C. M. Pieters, S. Besse, R. N. Clark, J. W. Head III, R. L. Klima, J. F. Mustard, N. E. Petro, M. I. Staid, J. M. Sunshine, L. A. Taylor, K. G. Thaisen, and S. Tompkins (2011), Remote compositional analysis of lunar olivine-rich lithologies with Moon Mineralogy Mapper (M3) spectra, *J. Geophys. Res.*, 116, E00G11, doi: 10.1029/2010JE003731.
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