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EDUCATION

Ph.D. Washington University in St. Louis, Earth & Planetary Science 2014
A.M. Washington University in St. Louis, Earth & Planetary Science 2011
B.S. Yale University, Geology & Geophysics with honors, Physics 2009

RESEARCH EXPERIENCE

Jet Propulsion Laboratory, research scientist, 2016 - present

California Institute of Technology, visiting associate, 2016 - present

California Institute of Technology, supervisor B. Ehlmann, 2014 - 2016

Texaco Prize Postdoctoral Scholar & Keck Institute for Space Studies Postdoctoral Scholar

Washington University in St. Louis, supervisor R. Arvidson, 2009 - 2014

Graduate researcher analyzing visible/near infrared spectra of Mars and its moons

National Academies of Science, supervisor D. Smith, 2009, 2007

Space Studies Board summer intern studying civil space research policy

Brown University, supervisor J. Mustard, 2008

Summer research student analyzing CRISM orbital data over Tyrrhena Terra, Mars

Cornell University, supervisor J. Bell, 2006

Summer research student analyzing Pancam multispectral data from Gusev Crater, Mars

Carnegie Institute of Washington, supervisor N. Haghipour and K.E.S. Ford, 2005, 2004

High school summer research student performing dynamical modeling of exoplanet system

PLANETARY MISSION PARTICIPATION

Mars Exploration Rover Mission, Deputy Project Scientist

Mars Science Laboratory, Participating Scientist

Compact Reconnaissance Imaging Spectrometer for Mars (CRISM), Co-I

FELLOWSHIPS AND AWARDS

NASA Early Career Public Achievement Medal, 2018

JPL Voyager Award, 2018

NASA Group Achievement Award, 2017, MSL Extended Mission-1 Science and Operations Team

Keck Institute for Space Studies Prize Postdoctoral Fellowship, 2014-2016

Caltech Geological & Planetary Science Div. Texaco Prize Postdoctoral Fellowship, 2014-2016

NASA Group Achievement Awards, 2013 & 2015 (MSL Prime Mission Science and Operations Team)

Washington University in St. Louis Graduate School of Arts & Science Student Marshal, 2014

Honor given to two outstanding graduates across all graduate degrees in physical sciences

P.E.O. Scholar Award, 2013

Mr. and Mrs. Spencer T. Olin Fellowship for Women in Graduate Study, 2012 - 2014

American Geophysics Union Fall Meeting Outstanding Student Paper Award, 2012

National Science Foundation Graduate Research Fellowship, 2009-2012

Samuel Lewis Penfield Prize, 2009

Yale Richter Fellowship for Summer Research, 2008

Planetary Geology & Geophysics Undergraduate Research Program grant, 2006

Intel Science Talent Search Finalist, 2005

National Merit Finalist, 2005

Red Rover Goes to Mars Student Astronaut, 2004

Sponsored by the Planetary Society, one of 16 international winners selected to work at the Jet Propulsion Laboratory during the beginnings of the Mars Exploration Rover mission and to share their experiences with the public

PUBLICATIONS

PEER REVIEWED PUBLICATIONS

26. **Fraeman, A.A.** 2018. "Commentary: Unraveling the history of Meridiani Planum, Mars: New chemical clues from the rim of Endeavour Crater," *Journal of Geophysical Research: Planets*, 123(3), 690-694.
25. Johnson, J.R., Bell III, J.F., Bender, S., Cloutis, E., Ehlmann, B., **Fraeman, A.**, Gasnault, O., Maurice, S., Pinet, P., Thompson, L., Wellington, D., Wiens, R.C. 2018. "Bagnold Dunes campaign Phase 2: Visible/near-infrared reflectance spectroscopy of longitudinal ripple sands," *Geophysical Research Letters*, 45(18):9480-9487.
24. McMahan, S., Bosak, T., Grotzinger, J.P., Milliken, R.E., Summons, R.E., Daye, M., Newman, S.A., **Fraeman, A.A.**, Williford, K.H., Briggs, D.E.G. 2018. "A Field Guide to Finding Fossils on Mars," *Journal of Geophysical Research: Planets*, 123(5), 1012-1040.
23. Lapotre, M., Ehlmann, B., Minson, S., Arvidson, R., Ayoub, F., **Fraeman, A.**, Ewing, R., Bridges, N. 2017. "Compositional Variations in Sands of the Bagnold Dunes at Gale Crater, Mars, from Visible-Shortwave Infrared Spectroscopy and Comparison to Ground-Truth from the Curiosity Rover," *Journal of Geophysical Research: Planets*, 122, 12.
22. Ehlmann, B., Edgett, K., Sutter, B., Achilles, C., Litvak, M., Lapotre, M., Sullivan, R., **Fraeman, A.**, Arvidson, R., Blake, D., Bridges, N., Conrad, P., Cousin, A., Downs, R., Cabriel, T., Gellert, R., Hamilton, V., Hardgrove, C., Johnson, J., Kuhn, S., Mahaffy, P., Maurice, S., McHenry, M., Meslin, P., Ming, D., Minitti, M., Morookian, J., Morris, R., O'Connell-Cooper, C., Pinet, P., Rowland, S., Schroder, S., Siebach, K., Stein, N., Thompson, L., Vaniman, D., Vasavada, A., Wellington, D., Wiens, R., Yen, A. 2017. "Chemistry, mineralogy, and grain properties of Namib and High dunes, Bagnold dune field, Gale crater, Mars: A synthesis of Curiosity rover observations," *Journal of Geophysical Research: Planets*, 122, 12.
21. Johnson, J., Achielles, C., Bell, J., Bender, S., Cloutis, E., Ehlmann, B., **Fraeman, A.**, Gasnault, O., Hamilton, V., Le Mouelic, S., Maurice, S., Pinet, P., Thompson, L., Wellington, D., Wiens, R. 2017. "Visible/near-infrared spectral diversity from in situ observations of the Bagnold Dune Field sands in Gale Crater, Mars," *Journal of Geophysical Research: Planets*,

20. Arvidson, R., DeGrosse, P., Grotzinger, J., Heverly, M., Shechet, J., Moreland, S., Newby, M., Stein, N., Steffy, A., Zhou, F., Zastrow, A., Vasavada, A., **Fraeman, A.**, Stilly, E. 2017. “Relating geologic units and mobility system kinematics contributing to Curiosity wheel damage at Gale Crater, Mars,” *Journal of Terramechanics*, 73, SI.
19. Wellington, D., Bell, J., Johnson, J., Kinch, K., Rice, M., Godber, A., Ehlmann, B., **Fraeman, A.**, Hardgrove, C., Le Mouélic, S. 2016, “Visible to Near-Infrared MSL/Mastcam Multispectral Imaging: Initial Results from Select High-Interest Science Targets within Gale Crater, Mars,” *American Mineralogist*, 102, 6.
18. Frydenvang, J., Gasda, P., Hurowitz, J., Grotzinger, J., Wiens, R., Newsom, H., Edgett, K., Watkins, J., Bridges, J., Maurice, S., Fisk, M., Ehlmann, B., Johnson, J., Rapin, W., Stein, N., Clegg, S., Schwenzer, S., Bedford, C., Edwards, P., Mangold, N., Cousin, A., Anderson, R., Payre, V., Vaniman, D., Blake, D., Lanza, N., Gupta, S., Van Beek, J., Sautter, V., Meslin, P., Rice, M., Milliken, R., Gellert, R., Thompson, L., Clark, B., Sumner, D., **Fraeman, A.**, Kinch, K., Madsen, M., Mitrofanov, I., Jun, I., Calef, F., Vasavada, A. 2017. “Diagenetic silica enrichment and late-stage groundwater activity in Gale Crater, Mars,” *GRL*, 44, 10.
17. Ehlmann, B., Anderson, F., Andrews-Hanna, J., Carter, J., Catling, D., Christensen, P., Cohen, B., Dressing, C., Edwards, C., Elkins-Tanton, L., Farley, K., Fassett, C., Fischer, W., **Fraeman, A.**, Golombek, M., Hamilton, V., Hayes, A., Herd, C., Horgan, B., Hu, R., Jakobsy, B., Johnson, J., Kasting, J., Kerber, L., Kinch, K., Kite, E., Knutson, H., Lunine, J., Mahaffy, P., Mangold, N., McCubbin, F., Mustard, J., Niles, P., Quantin-Nataf, C., Rice, M., Stack, K., Stevenson, D., Stewart, S., Toplis, M., Usui, T., Weiss, B., Werner, S., Wordsworth, R., Wray, J., Yingst, A., Yung, Y., Zahnle, K. 2016. “The Sustainability of Habitability on Terrestrial Planets: Insights, Questions, and Needed Measurements from Mars for Understanding the Evolution of Earth-like Worlds,” *Journal of Geophysical Research: Planets*, 121, 10.
- 16. Fraeman, A.**, Ehlmann, B., Arvidson, R., Edwards, C., Grotzinger, J., Milliken, R., Quinn, D., and Rice, M. 2016. “The Stratigraphy and Evolution of Lower Mt. Sharp from Spectral, Morphological, and Thermophysical Orbital Datasets,” *Journal of Geophysical Research: Planets*, 121, 9.
15. Arvidson, R., Iagnemma, K., Maimone, M., **Fraeman, A.**, Zhou, F., Heverly, M., Bellutta, P., Rubin, D., Stein, N., Grotzinger, J., Vasavada, A. 2015. “Mars Science Laboratory Curiosity Rover Megaripple Crossings up to Sol 710 in Gale Crater,” *Journal of Field Robotics*, 34, 3.
14. Stack, K., Edwards, C., Grotzinger, J., Gupta, S., Sumner, D., Calef, F., Edgar, L., Edgett, K., **Fraeman, A.**, Jacob, S., Le Deit, L., Lewis, K., Rice, M., Rubin, D., Williams, R., Williford, K. 2015. “Comparing orbiter and rover image-based mapping of an ancient sedimentary environment, Aeolis Palus, Gale crater, Mars,” *Icarus*, 280.
13. Johnson, J., Bell, J. F., Bender, S., Blaney, D., Cloutis, E., Ehlmann, B., **Fraeman, A.**, Gasnault, O., Kinch, K., Le Mouélic, S., Maurice, S., Rampe, E., Vaniman, D., Wiens, R. 2015. “Constraints on iron sulfate and iron oxide mineralogy from ChemCam visible/near-infrared reflectance spectroscopy of Mt. Sharp basal units, Gale Crater, Mars,” *American Mineralogist*, 101, 7-8.
12. Lapotre, M., Ewing, R., Lamb, M., Fischer, W., Grotzinger, J., Rubin, D., Lewis, K., Ballard,

- M., Day, M., Gupta, S., Banham, S., Bridges, N., De Marais, D., **Fraeman, A.**, Grant, J., Herkenhoff, K., Ming, D., Mischna, M., Rice, M., Sumner, D., Vasavada, A., Yingst, R. 2016. "Large wind ripples on Mars: A record of atmospheric evolution," *Science*, 353, 6294.
11. Greenberger, R., Mustard, J., Ehlmann, B., Blaney, D., Cloutis, E., Wilson, J., Green, R., **Fraeman, A.** 2015. "Imaging spectroscopy of geological samples and outcrops: novel insights from microns to meters," *GSA today*, 25, 12, doi: 10.1130/GSATG252A.1
 10. Seelos, K., Seelos, F., Vivano-Beck, C., Murchie, S., Arvidson, R., Ehlmann, B., **Fraeman, A.** 2014. "Mineralogy of the MSL Curiosity landing site in Gale crater as observed by MRO/CRISM," *Geophysical Research Letters*, 41, 14.
 9. Arvidson, R., Bellutta, P., Calef, F., **Fraeman, A.**, Garvin, J., Gasnault, O., Grant, J., Grotzinger, J., Hamilton, V., Heverly, M., Iagnemma, K., Johnson, J., Lanza, N., Le Mouelic, S., Mangold, N., Ming, D., Mehta, M., Morris, R., Newsom, H., Renno, N., Rubin, D., Schieber, J., Sletten, R., Vasavada, A., Viscaino, J., Wiens, R. 2014. "Terrain physical properties derived from orbital data and the first 360 sols of Mars Science Laboratory Curiosity rover operations in Gale Crater," *Journal Geophysical Research: Planets*, 119, doi: 10.1002/2013JE004605.
 8. **Fraeman, A.**, Murchie, S., Arvidson, R., Clark, R., Morris, R., Rivkin, A., Vilas, F. 2014. "Spectral absorptions on Phobos and Deimos in the visible/near infrared wavelengths and their compositional constraints," *Icarus*, 229, 196-205, doi: 10.1016/j.icarus.2013.11.021
 7. Grotzinger, J., Sumner, D., Kah, L., Stack, K., Gupta, S., Edgar, L., Rubin, D., Lewis, K., Schieber, J., Mangold, N., Milliken, R., Conrad, P., DesMarais, D., Farmer, J., Siebach, K., Calef III, F., Hurowitz, J., McClellan, S., Ming, D., Vaniman, D., Crisp, J., Vasavada, A., Edgett, K., Malin, M., Blake, D., Gellert, R., Mahaffy, P., Wiens, R., Maurice, S., Grant, J., Wilson, S., Anderson, R., Beegle, L., Arvidson R., Hallet, B., Sletten, R., Rice, M., Bell III, J., Griffes, J., Ehlmann, B., Anderson, R., Bristow, T., Dietrich, W., Dromart, G., Eigenbrode, J., **Fraeman, A.**, Hardgrove, C., Herkenhoff, K., Jandura, L., Kocurek, G., Lee, S., Leshin, L., Leveille, R., Limonadi, D., Maki, J., McCloskey, S., Meyer, M., Minitti, Newsom, H., M., Oehler, D., Okon, A., Palucis, M., Parker, T., Rowland, S., Squyers, S., Steele, A., Stolper, E., Summons, R., Treiman, A., Williams, R., Yingst, A. 2013. "A habitable fluvio-lacustrine environment at Yellowknife Bay, Gale Crater, Mars," *Science*, doi:10.1126/science.1242777.
 6. **Fraeman, A.**, Arvidson, R., Catalano, J., Grotzinger, J., Morris, R., Murchie, S., Seelos, F., Seelos, K., McGovern, J., Humm, D., Stack, K., Viviano, C. 2013. "A hematite-bearing layer in Gale Crater: mapping and implications for past aqueous conditions," *GEOLOGY*, 41, 1103-1106, doi:10.1130/G43613.1
 5. **Fraeman, A.**, Arvidson, R., Murchie, S., Rivkin, A., Bibring, J-P. Choo, T., Gondet, B., Humm, D., Kuzmin, D., Manaud, N., Zabalueva, E. 2012. "Analysis of disk-resolved OMEGA and CRISM spectral observations of Phobos and Deimos," *Journal of Geophysical Research: Planets*, 117, doi:10.1029/2012JE004137.
 4. Diniega, S., Sayanagi, K., Balcerski, J., Carande, B., Diaz-Silva, R., **Fraeman, A.**, Guzewich, S., Hudson, J., Nahm, A., Potter-McIntyre, S., Route, M., Urban, K., Vasisht, S., Benneke, B., Gil, S., Livi, R., Williams, B., Budney, C., Lowes, L. 2012. "Mission to the Trojan Asteroids: lessons learned during a JPL Planetary Science Summer School mission design exercise," *Planetary and Space Science*, 76, 68-82. doi:10.1016/j.pss.2012.11.011.

3. Ehlmann, B., Mustard, J., Murchie, S., Bibring, J-P., Meunier, A., **Fraeman, A.**, Langevin, Y. 2011. "Clay formation environments and potential habitats on early Mars," *Nature*, 497, 53-60. doi:10.1038/nature10582
2. **Fraeman, A.** and Korenaga, J. 2010. "The influence of mantle melting on the evolution of Mars," *Icarus*, 210, 43-57. doi:10.1016/j.icarus.2010.06.030
1. McGuire, P., Bishop, J., Brown, A., **Fraeman, A.**, Marzo, G., Morgan, M., Murchie, S., Mustard, J., Parente, M., Pelkey, S., Roush, T., Seelos, F., Smith, M., Wendt, L., Wolff, M. 2009. "An improvement to the volcano-scan algorithm for atmospheric correction of CRISM and OMEGA spectral data," *Planetary and Space Sciences*, 57, 809-815. doi:10.1016/j.pss.2009.03.007

PEER-REVIEWED CONFERENCE PAPERS

4. Wyatt, E.J., Castillo-Rogez, J., Chien, S., **Fraeman, A.**, Gao, J., Herzig, S., T. J. Lazio, T. Vaquero. "Autonomous Networking for Robotic Deep Space Exploration," 2018. International Symposium on Artificial Intelligence, Robotics and Automation in Space (*i-SAIRAS*).
3. **Fraeman, A.**, Ehlmann, B., Northwood-Smith, G., Liu, Y., Wadhwa, M., Greenberger, R. "Using VSWIR Microimaging Spectroscopy to Explore the Mineralogical Diversity of HED Meteorites," 2016. *IEEE Workshop on Hyperspectral Image and Signal Processing*.
2. **Fraeman, A.**, Arvidson, R., Grotzinger, J. "Curiosity's Traverse from the Kimberley to the Base of Mt. Sharp: An Orbital Data Perspective", 2014 *14th ASCE International Conference on Engineering, Science, Construction and Operations in Challenging Environments*.
1. Bosanac, N., Diaz, A., Dang, V., Ebersohn, F., Gonzalez, S., Qi, J., Sweet, N., Tie, N., Valentino, G., **Fraeman, A.**, Gibbings, A., Maddox, T., Nie, C., Rankin, J., Rebelo, T., and Taylor, G. "Manned sample return mission to Phobos: a technology demonstration for human exploration of Mars", 2014 *IEEE Aerospace Conference Paper*.

INTERN CONTRIBUTOR TO SPACE STUDIES BOARD REPORTS

3. Committee on the Planetary Science Decadal Survey, National Academy of Sciences, Space Studies Board (David Smith, study director), "Visions and Voyages for Planetary Science in the Decade 2013 – 2022," National Academies Press, 2011.
2. Committee on Assessing the Solar System Exploration Program, National Academy of Sciences, Space Studies Board (Dwayne Day, study director), "Grading NASA's Solar System Exploration Program: A Midterm Review," National Academies Press, 2008.
1. Assessment of the NASA Astrobiology Institute Panel, National Academy of Sciences, Space Studies Board (David Smith, study director), "Assessment of the NASA Astrobiology Institute," National Academies Press, 2007.

PRESENTATIONS

INVITED TALKS

8. **Fraeman, A.**, Sun, V., Edgar, L., Fedo, C., Fox, V., Grotzinger, J., Hardgrove, C., Horgan, B., House, C., et al. "Curiosity at Vera Rubin Ridge: Major Findings and Implications for Habitability," oral presentation at AGU Fall Meeting (2018).

7. **Fraeman, A.**, “Mapping Mineralogy at Gale Crater with Reflectance Spectroscopy,” SciX Conference. (2016).
6. **Fraeman, A.**, “Near Infrared Spectroscopy of Phobos and Deimos,” Tohoku University Forum for Creativity. (2016)
5. **Fraeman, A.**, “Phobos and Deimos: What we know, what we don’t know, and why we care,” UCLA iPLEX lunch seminar. (2016).
4. **Fraeman, A.**, “Materials and Surface Processes at Gale Crater and the Moons of Mars Derived from High Spatial and Spectral Resolution Orbital Datasets,” Caltech GeoClub speaker. (2014)
3. **Fraeman, A.**, "Phobos: A summary of current knowledge of its origin and evolution and key questions for future exploration," oral presentation at LPSC Microsymposium 55: Scientific Destinations for Human Exploration. (2014)
2. **Fraeman, A.**, Arvidson, R., Catalano, J., Morris, R., Murchie, S., Seelos, F., Seelos, K., McGovern, J., Viviano, C. "Hematite Bearing Ridge as Evidence for Anoxic Water Discharge in Gale Crater," oral presentation at GSA Fall Meeting. (2012)
1. **Fraeman, A.**, "New Techniques for Working with CRISM Data in Support of Opportunity and Curiosity Operations," NASA Jet Propulsion Laboratory Mars Seminar. (2012)

SUBMITTED CONFERENCE PRESENTATIONS - FIRST AUTHOR AND STUDENT (*)

36. **Fraeman, A.**, Squyres, S., Arvidson, R., Golombek, M., and MER Athena Science Team. “Overview of Recent Results from Opportunity’s Investigation of Endeavour Crater and Perseverance Valley,” poster presentation at AGU (2018).
35. **Fraeman, A.**, Edgar, L., Grotzinger, J., Vasavada, A., Johnson, J., Wellington, D., Fox, V., Sun, V., Hardgrove, C., Horgan, B., House, C., Johnson, S., Stack Morgan, K., Rampe, E., Thompson, L., Wiens, R., Williams, A. “Curiosity’s Investigation at Vera Rubin Ridge,” oral presentation at LPSC (2018).
34. *Putnam, E., **Fraeman, A.**, Stack, K. “Mineralogy of Martian Layered Deposits: A Global Survey,” poster presentation at LPSC (2018).
33. **Fraeman, A.**, Bedford, C., Bridges, J., Edgar, L., Hardgrove, C., Horgan, B., Gabriel, T., Grotzinger, J., Gupta, S., Johnson, R., Rampe, E., Morris, R., Salvatore, M., Schwenzer, S., Stack, K., Pinet, P., Rubin, D., Weitz, C., Wellington, D., Wiens, R., Williams, A., Vasavada, A. “Curiosity at Vera Rubin Ridge: Testable Hypotheses, First Results, and Implications for Habitability,” oral presentation at AGU (2017).
32. **Fraeman, A.**, Wyatt, E., Lazio, J., Castillo-Rogez, J., Chien, S., Herzig, S., Gao, J., Alibay, F., Belov, K., Ellison, D., Kim, H., Guy, N., Troesch, M., Walsh, W. “Benefits offered by a network of CubeSat-class rovers for planetary cave exploration,” oral presentation at Low Cost Planetary Missions Conference (2017).
31. **Fraeman, A.**, Arvidson, R., Fox, V., Horgan, B., Johnson, J., Wellington, D., Ehlmann, B., Grotzinger, J., Hurowitz, J., Bell, J. “The Distribution of Iron Oxides in Lower Mt. Sharp and Implications for Past Aqueous Conditions,” oral presentation at LPSC (2017).
30. **Fraeman, A.**, Golombek, M., Lamb, M., Palucis, M., Dickson, J., Squyres, S., Arvidson, R., Crumpler, L., Grant, J., Parker, T. “Opportunity Observations of Grooves in Endeavour Crater’s Rim,” poster presentation at LPSC (2017).
29. **Fraeman, A.**, Johnson, J., Wellington, D., Arvidson, R., Fischer, W., Grotzinger, J., Hurowitz, J., Stack, K., Bell, J., Cloutis, E., Maurice, S., Wiens, R. “Distribution of iron oxides in

- lower Mt. Sharp from Curiosity and orbital datasets, and implications for their formation,” poster presentation at AGU fall meeting (2016).
28. **Fraeman, A.**, Ehlmann, B., Liu, Y., Greenberger, R., Wadhwa, M. “Micrometer-Scale Spectral Properties of Howardite, Eucrite, and Diogenite Meteorites,” oral presentation at DPS/EPSC (2016).
 27. **Fraeman, A.**, Ehlmann, B., Arvidson, R., Edwards, C., Grotzinger, J. “The Evolution of Lower Mt. Sharp: An Orbital Perspective,” oral presentation at Goldschmidt (2016).
 26. **Fraeman, A.**, Ehlmann, B., Northwood-Smith, G., Liu, Y., Wadhwa, M., Greenberger, R. “Exploring the Mineralogical Diversity of HED Meteorites with Microimaging VSWIR Spectroscopy,” poster presentation at LPSC (2016).
 25. **Fraeman, A.**, Ehlmann, B., Arvidson, R., Edwards, C., Grotzinger, J., and Rice, M. “The Stratigraphy and Evolution of Lower Mt. Sharp from Spectral, Morphological, and Thermophysical Orbital Datasets,” oral presentation at LPSC (2016).
 24. **Fraeman, A.**, Edwards, C., Ehlmann, B., Arvidson, R., Horgan, B., Rices, M. “A Detailed Investigation of Lower Mt. Sharp using Coordinated Orbital Datasets,” oral presentation at GSA Annual Meeting (2015).
 23. **Fraeman, A.**, “Deciphering the History and Habitability of Gale Crater with Orbital and Rover Datasets,” oral presentation at 11th Recontres du Vietnam, Planetary Systems Conference (2015).
 22. **Fraeman, A.**, Arvidson, R., Ehlmann, B., Bridges, N., Clark, B., Cousin, A., Des Marais, D., Gellert, R., Johnson, J., Laportre, M., Schroder, S., Stein, N., Sullivan, R., Wellington, D., “Physical and Material Properties of Gale Crater Sandy Deposits: From Rocknest to Pahrump”, poster presentation at LPSC (2015).
 21. **Fraeman, A.**, Edwards, C., Ehlmann, B., Arvidson, R., and Johnson, J., “Exploring Curiosity’s Future Path from Orbit: The View of Lower Mt. Sharp from Integrated CRISM, HiRISE, and THEMIS Datasets,” poster presentation at LPSC (2015).
 20. **Fraeman, A.**, Edwards, C., Ehlmann, B., “Habitable Environments Preserved in Lower Mt. Sharp: Exploring Curiosity’s Future Path from Orbit,” poster presentation at 3rd ELSI International Symposium (2015).
 19. **Fraeman, A.**, Arvidson, R., Ehlmann, B., Grotzinger, J., Hamilton, V., Martín-Torres, J., Zorzano, M-P., “Compositional and Physical Properties of Materials Along Curiosity’s Traverse Inferred from CRISM Hyperspectral Data,” poster presentation at AGU Fall Meeting (2014).
 18. **Fraeman, A.**, Murchie, S., Arvidson, R., “Compositions of Phobos and Deimos: The View from Visible to Near Infrared Spectroscopy,” talk at SSERVI Exploration Science Forum (2014).
 17. **Fraeman, A.**, Arvidson, R., Seelos, K., Johnson, J., Murchie, S., Ehlmann, B., Grotzinger, J. “Curiosity’s Traverse from the Kimberley to the Base of Mt. Sharp: A CRISM Perspective,” poster presentation at 8th International Conference on Mars (2014).
 16. **Fraeman, A.**, Arvidson, R., Jolliff, B., Morris, R. "The Influence of the Textural Properties of Iron Oxides on their Visible to Near Infrared Spectra and Applications to Mars," poster presentation at 45th Lunar and Planetary Science Conference (2014).
 15. **Fraeman, A.**, Arvidson, R., Bellutta, P., Sletten, R., MSL Science Team. "Climbing Mt. Sharp: Maximizing Curiosity's Science Over Traversable Terrains," poster presentation at AGU Fall Meeting. (2013)
 14. **Fraeman, A.**, Murchie, S., Arvidson, R., Clark, R., Morris, R., Rivkin, A., and Vilas, F. "Constraints on the Compositions of Phobos and Deimos from Visible/Near Infrared Observations," oral presentation at 45th Annual AAS DPS Meeting. (2013)

13. **Fraeman, A.**, Murchie, S., Rivkin, A., Morris, R., Arvidson, R. "Constraints on the Compositions of Phobos and Deimos from Mineral Absorptions," oral presentation at 44th Lunar and Planetary Science Conference (2013).
12. **Fraeman, A.**, Arvidson, R., Bell, J., Ehlmann, B., Johnson, J., Morris, R., Murchie, S., Rice, M., Seelos, F., Seelos, K. "Curiosity's Traverse to Mount Sharp: Enhancing Scientific Investigation with Hyperspectral Orbital Data," poster presentation at 44th Lunar and Planetary Science Conference (2013).
11. **Fraeman, A.**, Arvidson, R., Catalano, J., Morris, R., Murchie, S., Seelos, F., Seelos, K., McGovern, J., Viviano, C. "Hematite Bearing Ridge as Evidence for Anoxic Water Discharge in Gale Crater," poster presentation at AGU Fall Meeting (2012).
10. **Fraeman, A.**, Arvidson, R., Murchie, S., Rivkin, A., Bibring, J.P., Gondet, B., Manaud, N., Langevin, Y., Choo, T., Humm, D. "Analysis of CRISM and OMEGA Observations of Phobos and Deimos," oral presentation at 43rd Lunar and Planetary Science Conference (2012).
9. **Fraeman, A.**, Arvidson, R., Ehlmann, B., McGovern, J., Milliken, R., Murchie, S., Seelos, F., Seelos, K. "Increasing the spatial resolution of oversampled CRISM images at Gale Crater," poster presentation at 43rd Lunar and Planetary Science Conference (2012).
8. **Fraeman, A.**, Arvidson, R., Murchie, S., Seelos, F., McGovern, J., Humm, D. "Analysis of Along Track Oversampled (ATO) CRISM Observations," poster presentation at AGU Fall Meeting (2011).
7. **Fraeman, A.**, Arvidson, R., Murchie, S., Seelos, F., McGovern, J. "Testable Hypotheses for Opportunity's Traverse from Santa Maria to the Rim of Endeavour Crater," poster presentation at 42nd Lunar and Planetary Science Conference (2011).
6. **Fraeman, A.**, Arvidson, R., Gondet, B., Bibring, J-P., Murchie, S., Choo, T., Humm, D., Manaud, N. "Photometric Properties of Phobos Derived from CRISM and OMEGA Observations," oral presentation at AGU Fall Meeting (2010).
5. **Fraeman, A.**, Arvidson, R., Gondet, B., Bibring, J-P., Murchie, S., Choo, T., Humm, D., Manaud, N. "The Effects of Viewing Geometry and Temperature on OMEGA and CRISM Phobos Observations," poster presentation at The First Moscow Solar System Symposium (2010).
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57. Fox, V., Arvidson, R., **Fraeman, A.** “Mineralogy of Mount Sharp, Gale Crater, Using Along Track Oversampled CRISM Observations to Support Path Planning for the Curiosity Rover,” 2017 LPSC.
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PROFESSIONAL WORKSHOPS & SERVICE

NASA Proposal Review Panels, Various, 2014-2018

Peer Reviewer, *Icarus*, *JGR Planets*, *Planetary & Space Sciences*, *Astronomy & Astrophysics Letters*, *PDS*

New Leaders in Space Studies Delegate, Joint workshop sponsored by the National Academy of Sciences and Chinese Academy of Sciences – 10/15, 5/16

Keck Institute for Space Studies Workshop, Mapping and Assaying the Near Earth Object Population Affordably on a Decadal Timescale – 8/14

Caltech Space Challenge, Human Mission Design Activity, selected participant - 3/13

Keck Institute for Space Studies Workshop, *In Situ* Science and Instrumentation for Primitive Bodies, invited participant - 5/12 and 2/13

Planetary Science Summer School, JPL TeamX Mission Design, selected participant - 8/11

TEACHING EXPERIENCE

Summer student mentor, Christopher Yen, JPL SURF Program, Summer 2018

Field Assistant, Bridge to Geosciences Citrus College Catalina Ocean Science Module, 2017, 2018

Guest Lecturer, Dartmouth Remote Sensing Class, Spring 2018

Summer student mentor, Ethan Putnam, JPL SURF Program, Summer 2017

Summer student mentor, Geraint Northwood-Smith, Caltech SURF Program, Summer 2015

Guest Lecturer, WUSTL E&PS 567: Planetary Materials, Fall 2013

Guest Lecturer, WUSTL E&PS 106: Exploring Planets: Current Missions- Freshman Seminar, Spring 2012

Teaching Assistant, WUSTL Path 202: Case Study: Southwestern United States, Spring 2012

Teaching Assistant, WUSTL Path 201: Land Dynamics and the Environment, Fall 2011

RELEVANT COMPUTER SKILLS

Proficient in IDL, ENVI, Matlab, ArcMap. Microsoft Word, Excel, and PowerPoint. Some limited experience with Geochemist's Workbench.