

# Paul O. Hayne

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**Summary** My research focuses on the surfaces and atmospheres of icy planets and moons. I develop computational models and use the latest observational data to better understand these planetary bodies. Teaching, mentoring, and public engagement are also fundamental to my work.

**Positions Held**  
**University of Colorado, Boulder**  
*Assistant Professor*, January 2018 – present  
Astrophysical & Planetary Sciences Department,  
and Laboratory for Atmospheric & Space Physics

**NASA – Jet Propulsion Laboratory**, California Institute of Technology  
*Research Scientist*, 2012 – 2017

**California Institute of Technology**  
*Postdoctoral Scholar*, 2011 – 2012 (Advisor: Oded Aharonson)

**Education**  
**University of California, Los Angeles**  
*Ph.D.*, Geophysics & Space Physics, 2010 (Advisor: David A. Paige)  
**Stanford University**  
*M.S.*, Geophysics, 2005 (Advisors: Norman H. Sleep & Jack J. Lissauer)  
*B.S.*, Geophysics, 2003

**Mission Involvement**  
**NASA Lunar Compact Infrared Imaging System (L-CIRiS)**  
*Principal Investigator* (2019–present)  
**NASA Janus**  
*Co-Investigator and Instrument Scientist* (2019–present)  
Thermal IR Camera  
**NASA Europa Clipper**  
*Co-Investigator* (2017–present) and *Investigation Scientist* (2015–2018)  
Europa Thermal Emission Imaging System (E-THEMIS)  
**NASA Mars Reconnaissance Orbiter**  
*Co-Investigator* (2017–present)  
Mars Climate Sounder  
**NASA Lunar Flashlight**  
*Co-Investigator* (2012–present)  
**NASA Lunar Reconnaissance Orbiter**  
*Co-Investigator* (2011–present)  
Diviner Lunar Radiometer Experiment  
*Science Team Affiliate: NASA Dawn at Ceres* (2016–2019) and  
**NASA/ESA Cassini-Huygens Mission to Saturn** (2006–2014)

Visiting  
Appointments

**Lawrence Livermore National Laboratory**

*Visiting Scientist* (2017)

Planetary Defense Program / Weapons and Complex Integration (WCI)

**Weizmann Institute of Science, Israel**

*Visiting Scientist* (2015, 2016)

The Helen Kimmel Center for Planetary Science

Leadership  
& Service  
(External)

**Keck Institute for Space Studies, California Institute of Technology**

*Study Co-Lead*

2017–2018: [Unlocking the Climate Record Stored within Mars' Polar Layered Deposits](#)

2013–2014: [New Approaches to Lunar Ice Detection and Mapping](#)

**American Astronomical Society, Division for Planetary Sciences**

*Member* of the Federal Relations Subcommittee (2017–present)

*Local Organizing Committee*, Annual Meeting (2016)

*Panelist*, Annual Meeting (2015)

**American Geophysical Union**

*Session Organizer* (Mars Atmosphere), Annual Meeting (2014–2020)

**Young Scientists for Planetary Exploration**

*Co-founder* (2012) and *Co-leader* (2012–present)

World-wide advocacy organization for early-career planetary scientists

**Ad Astra Academy**

*Co-founder and Co-leader*, Ad Astra - Brazil (2015–present)

Science and exploration program for school-aged students in developing countries

**NASA Science Mission Directorate**

*Appointed Member*, Mars Exploration Program:

Ice and Climate Evolution Science Assessment Group (2018–2019)

*Review Panel Member* (2012–present)

**National Research Council – Space Studies Board**

*Raconteur*, Planetary Science Decadal Survey (2009–2010)

**Earth & Space Sciences Student Organization, UCLA**

*President* (2007–2008)

**Stanford Astronomical Society**

*President* (2002–2004)

**Referee** for major scientific journals:

*Journal of Geophysical Research*

*Geophysical Research Letters*

*Icarus*

*Astrophysical Journal*

*Planetary & Space Science*

*Advances in Space Research*

*Space Science Reviews*

*Geology*

*Science Advances*

*Nature Astronomy*

Honors & Awards	2013	<i>NASA Group Achievement Award</i> , Diviner Lunar Radiometer science team
	2011	<i>NASA Group Achievement Award</i> , Mars Climate Sounder science team
	2010	<i>Best Student Paper Award</i> , NASA Lunar Science Forum
	2010	<i>NASA Group Achievement Award</i> , Diviner Lunar Radiometer operations team
	2010	<i>NASA Group Achievement Award</i> , Diviner Lunar Radiometer science team
	2008	<i>Simon Latimer Award for Service</i> , UCLA
	2006	<i>Graduate Fellowship</i> , Institute of Geophysics and Planetary Physics
	2006	<i>Chancellor's Prize</i> , UCLA
	2001	<i>Graduate Fellowship</i> , Dept. of Geophysics, Stanford University

Departmental Service	<i>Committee Membership:</i>		
	2020/2021	Fall Semester Planning Committee	CU APS
	2020/2021	Grad Welcome and Social Committee	CU APS
	2019/2020	Social Committee (Chair)	CU APS
	2019/2020	Colloquium Committee	CU APS
	2019/2020	Undergraduate Curriculum and Concerns Comm.	CU APS
	2018/2019	Social Committee (Acting Chair)	CU APS
	2018/2019	Colloquium Committee	CU APS
	<i>Undergraduate Mentoring:</i>		
	2018–present	APS Department Undergraduate Student Mentor	
2018–present	APS Department Graduate Student Mentor		
<i>Additional Service:</i>			
2018-2019	Co-organizer: “Planet Lunch”	CU Boulder	
2018-2020	Organizer: Natural Sciences New Faculty Coffee	CU Boulder	

Exam Committee Service	<i>Comprehensive Examinations:</i>				
	2020	E. Fernando Cruz	Comps II	CU APS	Non-advocate Chair
	2020	Rachel Hoover	Comps II	CU GEOL	
	2019	Eryn Cangi	Comps II	CU APS	
	2019	Noora Alsaeed	Comps II	CU APS	Non-advocate Chair
	2019	Raven Larson	Comps II	CU APS	Research Advisor
	2019	Andrew Wilcoski	Comps II	CU APS	Research Advisor
	2019	Perianne Johnson	Comps II	CU APS	Non-advocate Chair
	2019	William Waalkes	Comps II	CU APS	
	2018	Momchil Molnar	Comps II	CU APS	
2018	Arika Egan	Comps II	CU APS		
<i>Dissertation Defenses:</i>					
2019	Dr. Marek Slipski		CU APS		
<i>Honors Thesis Defenses:</i>					
2019	Carlos Eytan Gary Bicas		CU APS		
2018	Amanda Alexander		CU GEOL		

## Teaching

### **University of Colorado Boulder**

*ASTR 3750: Planets, Moons, and Rings* (Fall, 2020)

Co-Professor (w/ David Brain) for undergraduate majors course (~100 students)

*ASTR 5800: Planetary Surfaces & Interiors* (Fall, 2019)

Professor for graduate course (~15 students)

*ASTR 1030: Accel. Introductory Astronomy* (Fall, 2018)

Professor for undergraduate majors course (115 students)

*ASTR 3720: Planets and their Atmospheres* (Spring, 2018)

Professor for upper-division undergraduate course (84 students)

### **California Institute of Technology**

*Ge 151: Planetary Surfaces* (2011)

Guest Lecturer for graduate course (~6 students)

### **University of California, Los Angeles**

*ESS 10: Exploring Mars* (2008)

Teaching Assistant and Guest Lecturer for undergraduate course (60 students)

### **Stanford University**

*Geophysics 150: Physics of the Earth* (2004, 2005)

Teaching Assistant for graduate course (~6 students)

*Physics 50: Observational Astronomy* (2002, 2003)

Teaching Assistant for undergraduate course (~20 students)

## Mentoring

### **Laboratory for Atmospheric and Space Physics**

#### *Postdocs*

2019–present: Dr. Margaret Landis

#### *Graduate Students*

2020–present: Kya Sorli (APS Dept., U. Colorado)

2020–present: Noora Alsaeed (APS Dept., U. Colorado)

2018–present: Andrew Wilcoski (APS Dept., U. Colorado)

#### *Undergraduate Students*

2018–present: Tara Tomlinson (APS Dept., U. Colorado)

2019–present: Shaelyn Raposa (CU Boulder, B.S. → N. Ariz. U., Ph.D.)

2018–2019: Carlos Eytan Gary Bicas (CU Boulder, B.S. → Stony Brook U., Ph.D.)

2018–2019: Tyler Horvath (CU Boulder, B.S. → UCLA, Ph.D.)

### **Caltech Summer Undergraduate Research Fellows (SURF)**

2017: James Haber (Cornell University, B.S. → Purdue U., Ph.D.)

2015: Léa Bonnefoy (Cornell University, B.S. → U. Arizona, Ph.D.)

2014: Clifford Watkins (Carleton College, B.S. → U. Hawaii, Ph.D.)

2011: Michael Lauria (Caltech, B.S.)

### **Maximizing Student Potential (MSP)**

2015–2018: José Martínez Camacho (Citrus College → SMU, Ph.D.)

### **Caltech Postdoctoral Fellows at JPL**

2017–2018: Dr. Quentin Vinckier (*co-mentor* with Dr. R. Glenn Sellar)

2016–2018: Dr. Catherine M. Elder

External Grants	2019–2022	<i>Lunar Compact Infrared Imaging System (L-CIRiS)</i> PI: P. Hayne NASA Lunar Science and Instrument Technology Payloads / \$3,000,000
	2019–2021	<i>Janus Mission</i> PI: D. Scheeres (Co-I: P. Hayne) NASA SIMPLEX Program / ~ \$100,000 for P. Hayne
	2015–2026	<i>Europa Thermal Emission Imaging System</i> PI: P. Christensen (Co-I: P. Hayne) NASA Europa Clipper Mission / ~\$200,000 allocation for P. Hayne
	2013–2021	<i>Lunar Flashlight Science Investigation</i> PI: B. Cohen (Co-I: P. Hayne) NASA Advanced Exploration Systems / ~\$600,000 for P. Hayne
	2016–2022	<i>Lunar Reconnaissance Orbiter Extended Mission 3 &amp; 4</i> PI: D. Paige (Co-I: P. Hayne) NASA Discovery Program / ~\$1,200,000 allocation for P. Hayne
	2016–2022	<i>Mars Reconnaissance Orbiter Extended Mission 4 &amp; 5</i> PI: J. T. Schofield (Co-I: P. Hayne) NASA Mars Program / ~\$640,000 allocation for P. Hayne
	2018–2021	<i>Boulders on Bennu: Modeling Thermal Emission from Boulders for Yarkovsky Effect and Thermal Inertia Investigations</i> PI: P. Hayne (Science PI: C. Elder) NASA OSIRIS-REx Participating Scientist Program / \$346,000
	2017–2018	<i>Unlocking the Climate Record Stored within Mars' Polar Layered Deposits</i> PI: P. Hayne W. M. Keck Institute for Space Studies / \$50,000
	2015–2018	<i>Inter-seasonal and Inter-annual Surface Dust Fluxes on Mars</i> PI: P. Hayne (Science PI: S. Piqueux) NASA Mars Data Analysis Program / \$330,690
	2013–2017	<i>Volatile Regolith Thermal Investigation Consortium for Exploration and Science (VORTICES)</i> PI: A. Rivkin (Co-I: P. Hayne) NASA Solar System Exploration Research Virtual Institute / ~\$120,000

- 2014–2016 *Thermal Infrared Observations of the Moon during Lunar Eclipse*  
 PI: P. Lucey (Co-I: P. Hayne)  
 NASA Planetary Astronomy / \$142,810 allocation for P. Hayne
- 2013–2014 *Development of Large Format Rad-Hard Focal Plane Arrays and Readouts for Thermal Radiometer for Europa Clipper Mission*  
 PI: M. Kenyon (Co-I: P. Hayne)  
 Instrument Concepts for Europa Exploration / \$16,460 for P. Hayne
- 2013–2014 *New Approaches to Lunar Ice Detection and Mapping*  
 PI: P. Hayne  
 W. M. Keck Institute for Space Studies / \$50,000

Invited Lectures

- 2020 NASA Lunar Surface Science Workshop  
 2018 Applied Physics Laboratory, Johns Hopkins University  
 2017 Lawrence Livermore National Laboratory  
 2017 University of Colorado, Boulder  
 2016 Lunar & Planetary Institute  
 2016 Weizmann Institute of Science (Israel)  
 2015 International Space Exploration Coordination Group,  
 2015 NASA Exploration Science Forum  
 2015 University of California - Santa Cruz  
 2014 SETI Institute  
 2013 Lunar & Planetary Institute  
 2012 California Institute of Technology  
 2012 NASA – Jet Propulsion Laboratory

Professional Affiliations

- American Astronomical Society - Division for Planetary Sciences  
 American Geophysical Union  
 European Geosciences Union  
 Asia Oceania Geosciences Society  
 Geochemical Society  
 Sigma Xi

Skills & Training

**Remote sensing & spacecraft instrumentation,  
 Modeling and numerical simulation**

**Computer programming languages**

Proficient/expert: C/C++, Python, MATLAB, IDL  
 Familiar: Fortran 90/95, awk, javascript, etc.

**Mission formulation experience**

*Team-X*, NASA Jet Propulsion Laboratory  
*Team-A*, NASA Jet Propulsion Laboratory  
*Capture Lead Training*, NASA Jet Propulsion Laboratory  
 Co-I and Deputy PI on mission proposals to NASA's *Discovery* and *New Frontiers* programs  
 PI on multiple instrument proposals to NASA mission programs

**Additional training**

*Astrobiology Winter School and Field Course* (2011)  
*International Astrobiology Summer School* (2008)  
*PADI Open Water Diver* scuba certification (50+ dives)  
*Eagle Scout* (1998), BSA Troop 676, Issaquah, WA

## Publications: Refereed Journal Articles

**Number of peer-reviewed publications: 53** (as of August, 2020)

First-author: 8 / Student first-author: 2 / Postdoc first-author: 3

*h-index*: 23 (Web of Science), 24 (Google Scholar)

Total citations: 1,528 (Web of Science), 2,044 (Google Scholar)

(\*) indicates (U,G) **student** or **postdoc** supervised or co-supervised by Hayne

2020

0. \*(G) Wilcoski, A. X. & Hayne, P. O. (2020), Surface roughness evolution and implications for the age of the north polar residual cap of Mars. In revision, *J. Geophys. Res.*
0. \*(U) Horvath, T., Hayne, P. O., & Paige, D. A. (2020), Thermal and illumination environments in lunar pits and caves. In revision, *Geophys. Res. Lett.*
1. Hayne, P. O., Aharonson, O., & Schörghofer, N. (2020), Micro cold traps on the Moon, *Nature Astron.*, accepted Aug. 2020.
2. \*(U) Gary-Bicas, C. E., Hayne, P. O., \*(U) Horvath, T., Heavens, N. G., Kass, D. M., Kleinböhl, A., Piqueux, S., Shirley, J., & McCleese, D. J. (2020), Asymmetries in snowfall, emissivity and albedo of Mars' seasonal polar caps: Mars Climate Sounder observations. *J. Geophys. Res.*, 125(5), e2019JE006150.
3. Feng, J., Siegler, M. A., & Hayne, P. O. (2020), New Constraints on Thermal and Dielectric Properties of Lunar Regolith from LRO Diviner and CE-2 Microwave Radiometer, *J. Geophys. Res.*, 125(1), e2019JE006130.
4. Siegler, M. A., Feng, J., Lucey, P. G., Ghent, R. R., Hayne, P. O., & White, M. N. (2020), Lunar titanium and frequency dependent microwave loss tangent as constrained by the Chang'E-2 MRM and LRO Diviner Lunar Radiometers, *J. Geophys. Res.*, e2020JE006405.
5. Cohen, B. A., Hayne, P. O., Greenhagen, B., Paige, D. A., Seybold, C., & Baker, J. (2020), Lunar Flashlight: Illuminating the Lunar South Pole, *IEEE Aerospace and Electronic Systems*, 35(3), 46-52.
6. Smith, I. B., Hayne, P. O., Byrne, S., Becerra, P., Kahre, M., Calvin, W., ... & Horgan, B. (2020), The Holy Grail: A road map for unlocking the climate record stored within Mars' polar layered deposits, *Planet. Space Sci.*, 184, 104841.

2019

7. Buhler, P. B., Ingersoll, A. P., Piqueux, S., Ehlmann, B. E., **Hayne, P. O.** (2019), Coevolution of Mars's atmosphere and massive south polar CO<sub>2</sub> ice deposit. *Nature Astron.* doi: [10.1038/s41550-019-0976-8](https://doi.org/10.1038/s41550-019-0976-8)
8. \***Hofgartner, J. D.**, Buratti, B. J., **Hayne, P. O.**, Young, L. A. (2019), Ongoing resurfacing of KBO Eris by volatile transport in local, collisional, sublimation atmosphere regime. *Icarus*, *334*, 52–61. doi: [10.1016/j.icarus.2018.10.028](https://doi.org/10.1016/j.icarus.2018.10.028)
9. Piqueux, S., ..., **Hayne, P. O.** (2019), Widespread shallow water ice on Mars at high latitudes and midlatitudes. *Geophys. Res. Lett.*, *46*, 14,290–14,298. doi: [10.1029/2019GL083947](https://doi.org/10.1029/2019GL083947)
10. Farrell, W. M., Hurley, D. M., Poston, M. J., **Hayne, P. O.**, Szalay, J. R., & McLain, J. L. (2019), The young age of the LAMP-observed frost in lunar polar cold traps. *Geophys. Res. Lett.*, in press. doi: [10.1029/2019GL083158](https://doi.org/10.1029/2019GL083158)
11. Sefton-Nash, E., Williams, J. P., Greenhagen, B. T., Warren, T. J., Bandfield, J. L., Aye, K. M., Leader, F., Siegler, M. A., **Hayne, P. O.**, & Paige, D. A. (2019), Evidence for ultra-cold traps and surface water ice in the lunar south polar crater Amundsen. *Icarus*, *332*, 1–13. doi: [10.1016/j.icarus.2019.06.002](https://doi.org/10.1016/j.icarus.2019.06.002)
12. Hendrix, A. R., Hurley, D. M., Farrell, W. M., Greenhagen, B. T., **Hayne, P. O.**, Retherford, K. D., ... & Liu, Y. (2019), Diurnally migrating lunar water: evidence from ultraviolet data, *Geophys. Res. Lett.*, *46*(5), 2417–2424. doi: [10.1029/2018GL081821](https://doi.org/10.1029/2018GL081821)
13. Jordan, A. P., Stubbs, T. J., Shusterman, M. L., Izenberg, N. R., Wilson, J. K., **Hayne, P. O.**, ... & Spence, H. E. (2019), How dielectric breakdown may contribute to the global weathering of regolith on the moon, *Icarus*, *319*, 785–794. doi: [10.1016/j.icarus.2018.10.025](https://doi.org/10.1016/j.icarus.2018.10.025)
14. Bapst, J., Byrne, S., Bandfield, J. L., & **Hayne, P. O.** (2019), Thermophysical properties of the north polar residual cap using MGS TES, *J. Geophys. Res.*, in press. doi: [10.1029/2018JE005786](https://doi.org/10.1029/2018JE005786)
15. \***Vinckier, Q.**, Hardy, L., Gibson, M., Smith, C., Putman, P., **Hayne, P. O.**, & Sellar, R. G. (2019), Design and characterization of the multi-band SWIR receiver for the Lunar Flashlight CubeSat Mission, *Remote Sensing*, *11*(4), 440. doi: [10.3390/rs11040440](https://doi.org/10.3390/rs11040440)
16. Landis, M. E., Byrne, S., Combe, J. P., Marchi, S., Castillo-Rogez, J., Sizemore, H. G., Schörghofer, N., Prettyman, T. H., **Hayne, P. O.**, Raymond, C. A., & Russell, C. T. (2019), Water vapor contribution to Ceres' exosphere from observed surface ice and postulated ice-exposing impacts, *J. Geophys. Res.*, *124*(1), 61–75.

2018

17. Williams, J-P., Bandfield, J. L., Paige, D. A., Powell, T. M., Greenhagen, B. T., Taylor, S., **Hayne, P. O.**, Speyerer, E. J., Ghent, R. R., & Costello, E. S. (2018), Lunar cold spots and crater production on the Moon, *Journal of Geophysical Research: Planets*, *123* (9), 2380–2392. doi: [10.1029/2018JE005652](https://doi.org/10.1029/2018JE005652).
18. Heavens, N. G., Kleinböhl, A., Chaffin, M. S., Halekas, J. S., Kass, D. M., **Hayne, P. O.**, McCleese, D. J., Piqueux, S., Shirley, J. H., & Schofield, J. T. (2018), Hydrogen escape from Mars enhanced by deep convection in dust storms, *Nature Astronomy*, *2*, 126–132. doi: [10.1038/s41550-017-0353-4](https://doi.org/10.1038/s41550-017-0353-4).
19. Li, S., Lucey, P. G., Milliken, R. E., **Hayne, P. O.**, Fisher, E., Williams, J-P., Hurley, D. M., Elphic, R. C. (2018), Direct evidence of surface exposed water ice in the lunar polar regions, *Proceedings of the National Academy of Sciences*, *115* (36), 8907–8912. doi: [10.1073/pnas.1802345115](https://doi.org/10.1073/pnas.1802345115).



- 2017 20. **Hayne, P. O.**, Bandfield, J. L., Siegler, M. A., Vasavada, A. R., Ghent, R. R., et al. (2017), Global regolith thermophysical properties of the Moon from the Diviner Lunar Radiometer Experiment, *J. Geophys. Res.*, *122*, 2371–2400. doi: [10.1002/2017JE005387](https://doi.org/10.1002/2017JE005387)
21. \***Elder, C. M.**, **Hayne, P. O.**, Bandfield, J. L., Ghent, R. R., Williams, J.-P., Donaldson Hanna, K. L., & Paige, D. A. (2017), Young lunar volcanic Features: Thermophysical properties and formation, *Icarus*, *290*, 224–237. doi: [10.1016/j.icarus.2017.03.004](https://doi.org/10.1016/j.icarus.2017.03.004)
22. Mitri, G., Postberg, F., Soderblom, J. M., ..., **Hayne, P. O.**, et al. (2017), Explorer of Enceladus and Titan (E<sup>2</sup>T): Investigating ocean worlds' evolution and habitability in the solar system, *Planetary and Space Science*, doi: [10.1016/j.pss.2017.11.001](https://doi.org/10.1016/j.pss.2017.11.001)
23. Landis, M. E., Byrne, S., Schörghofer, N., Schmidt, B. E., **Hayne, P. O.**, Castillo-Rogez, J., ... Russell, C. T. (2017), Conditions for sublimating water ice to supply Ceres' exosphere, *J. Geophys. Res.*, *122*, 1984–1995. doi: [10.1002/2017JE005335](https://doi.org/10.1002/2017JE005335)
24. Davies, A. G., Gunapala, S., Soibel, A., Ting, D., Rafol, S., Blackwell, M., **Hayne, P. O.**, & Kelly, M. (2017), A novel technology for measuring the eruption temperature of silicate lavas with remote sensing: Application to Io and other planets, *J. Volcanology & Geothermal Res.*, *343*, 1–16. doi: [10.1016/j.jvolgeores.2017.04.016](https://doi.org/10.1016/j.jvolgeores.2017.04.016)
25. Fisher, E. A., Lucey, P. G., Lemelin, M., Greenhagen, B. T., Siegler, M. A., Mazarico, E., Aharonson, O., Williams, J.-P., **Hayne, P. O.**, Neumann, G. A., Paige, D. A., Smith, D. E., & Zuber, M. T. (2017), Evidence for surface water ice in the lunar polar regions using reflectance measurements from the Lunar Orbiter Laser Altimeter and temperature measurements from the Diviner Lunar Radiometer Experiment, *Icarus*, *292*, 74–85. doi: [10.1016/j.icarus.2017.03.023](https://doi.org/10.1016/j.icarus.2017.03.023)
- 2016
26. Piqueux, S., Kleinböhl, A., **Hayne, P. O.**, Heavens, N. G., Kass, D. M., McCleese, D. J., ... & Shirley, J. H. (2016), Discovery of a widespread low-latitude diurnal CO<sub>2</sub> frost cycle on Mars, *J. Geophys. Res.*, *121*, 1174–118. doi: [10.1002/2016JE005034](https://doi.org/10.1002/2016JE005034)
27. Greenhagen, B. T., Neish, C. D., Williams, J. P., Cahill, J. T., Ghent, R. R., **Hayne, P. O.**, ... & Bandfield, J. L. (2016), Origin of the anomalously rocky appearance of Tsiolkovskiy crater, *Icarus*, *273*, 237–247. doi: [10.1016/j.icarus.2016.02.041](https://doi.org/10.1016/j.icarus.2016.02.041)
28. Bennett, K. A., Horgan, B. H., Gaddis, L. R., Greenhagen, B. T., Allen, C. C., **Hayne, P. O.**, ... & Paige, D. A. (2016), Complex explosive volcanic activity on the Moon within Oppenheimer crater, *Icarus*, *273*, 296–314. doi: [10.1016/j.icarus.2016.02.007](https://doi.org/10.1016/j.icarus.2016.02.007)
29. \*(U) **Bonnefoy, L. E.**, A. G. Hayes, **P. O. Hayne**, et al. (2015), Compositional and spatial variations in Titan dune and interdune regions from Cassini VIMS and RADAR, *Icarus*, *270*, 222–237, doi:[10.1016/j.icarus.2015.09.014](https://doi.org/10.1016/j.icarus.2015.09.014)

2015

30. **Hayne, P. O.**, and Oded Aharonson (2015), Thermal stability of ice on Ceres with rough topography, *J. Geophys. Res.*, *120*, 1567–1584, doi: [10.1002/2015JE004887](https://doi.org/10.1002/2015JE004887)
31. Heavens, N. G., Cantor, B. A., **Hayne, P. O.**, et al. (2015), Extreme detached dust layers near Martian volcanoes: Evidence for dust transport by mesoscale circulations forced by high topography, *Geophys. Res. Lett.*, *42*, 10, 3730–3738. doi: [10.1002/2015GL064004](https://doi.org/10.1002/2015GL064004)
32. **Hayne, P. O.**, A. R. Hendrix, E. Sefton-Nash, P. G. Lucey, K. D. Retherford, J-P. Williams, et al. (2015), Evidence for exposed water ice in the Moon’s south polar regions from Lunar Reconnaissance Orbiter ultraviolet albedo and temperature measurements, *Icarus*, *255*, 58–69, doi:[10.1016/j.icarus.2015.03.032](https://doi.org/10.1016/j.icarus.2015.03.032)
33. Glotch, T. D., Bandfield, J. L., Lucey, P. G., **Hayne, P. O.**, et al. (2015), Formation of lunar swirls by magnetic field standoff of the solar wind, *Nature Communications*, *6*. doi: [10.1038/ncomms7189](https://doi.org/10.1038/ncomms7189)
34. Piqueux, S., Kleinböhl, A., **Hayne, P. O.**, Kass, D. M., Schofield, J. T., & McCleese, D. J. (2015), Variability of the Martian seasonal CO<sub>2</sub> cap extent over eight Mars Years, *Icarus*, doi:[10.1016/j.icarus.2014.10.045](https://doi.org/10.1016/j.icarus.2014.10.045)
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2014

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## Publications: Book Chapters & Reports

1. Smith, I. B., Byrne, S., **Hayne, P. O.**, & 34 co-authors (2018), “Unlocking the Climate Record Stored in Mars’ Polar Layered Deposits,” *Keck Institute for Space Studies Report*. [[PDF](#)]
2. Aharonson, O., A. Hayes, **P. O. Hayne**, R. Lopes, A. Lucas, J. T. Perron, (2012), Titan’s Surface Geology, in: C. G. Mueller-Wodarg, T. Cravens and E. Lellouch (Ed.), *Titan: Surface, Atmosphere and Magnetosphere*, Cambridge University Press, Cambridge, UK.
3. **Hayne, P. O.**, A. P. Ingersoll, D. A. Paige, & 32 co-authors (2014), “New approaches to lunar ice detection and mapping,” *Keck Institute for Space Studies Report*. [[PDF](#)]

## Publications: Commentaries

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