

Paul O. Hayne

University of Colorado, Boulder
Astrophysical & Planetary Sciences Department
391 UCB
Boulder, CO 80309

Paul.Hayne@Colorado.edu
<https://www.colorado.edu/aps/paul-hayne>
Office: Duane Physics D321 || LASP-SPSC N294
Phone: (303) 735-6399 [O] (720) 390-9276 [M]

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

Positions Held
University of Colorado, Boulder
2024 – present *Associate Professor* (with tenure)
2018 – 2024 *Assistant Professor*
Astrophysical & Planetary Sciences Department,
and Laboratory for Atmospheric & Space Physics

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

California Institute of Technology
2011 – 2012 *Postdoctoral Scholar* (Supervisor: O. Aharonson)

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

Mission Experience
Emirates Mission to the Asteroid belt (EMA), UAE Space Agency
and Laboratory for Atmospheric & Space Physics
Project Scientist (2021–present)
NASA Lunar Compact Infrared Imaging System (L-CIRiS)
Principal Investigator (2019–present), CLPS-CP22 lunar south polar mission
NASA Lunar-Vulkan Imaging and Spectroscopy Explorer (Lunar-VISE)
Co-Investigator (2019–present)
Investigation Lead, Lunar-VISE Compact Infrared Imaging System (LV-CIRiS)
NASA Europa Clipper
Co-Investigator (2017–present) and *Investigation Scientist* (2015–2018)
Europa Thermal Emission Imaging System (E-THEMIS)
NASA Janus
Co-Investigator and *Investigation Lead* (2019–2024)
Thermal IR Camera
NASA Mars Reconnaissance Orbiter
Co-Investigator (2017–present)
Mars Climate Sounder

Mission
Experience
(cont.)

NASA Lunar Flashlight
Co-Investigator (2012–2023)

NASA Lunar Reconnaissance Orbiter
Co-Investigator (2011–present)
Diviner Lunar Radiometer Experiment

Science Team Affiliate: **NASA CLPS/IM-2 South Pole** Moon3D camera (2024–present)
NASA OSIRIS-REx (2018–2020), **NASA Dawn** (2016–2019),
NASA/ESA Cassini-Huygens (2006–2014)

Selected
External
Grants
&
Contracts

- 2025–2027 *Advanced 3-d Thermophysical Model to Enable Europa Clipper Interdisciplinary Science*
PI: P. Hayne
NASA Precursor Science Investigations for Europa
\$261k
- 2019–2028 *Lunar Vulkan Imaging and Spectroscopy Explorer (Lunar-VISE)*
PI: K. Donaldson Hanna (Co-I/Instrument Lead: P. Hayne)
NASA Payloads and Research Investigations on the Surface of the Moon (PRISM)
\$35M (\$2.2M subaward to LASP)
- 2019–2028 *Lunar Compact Infrared Imaging System (L-CIRiS)*
PI: P. Hayne
NASA Lunar Science and Instrument Technology Payloads / \$4.1M
- 2015–2034 *Europa Thermal Emission Imaging System*
PI: P. Christensen (Co-I: P. Hayne)
NASA Europa Clipper Mission / ~\$600k subaward to LASP for Phases D–E
- 2016–2025 *Lunar Reconnaissance Orbiter Extended Missions 3–5*
PI: D. Paige (Co-I: P. Hayne)
NASA Discovery Program / ~\$2.2M allocation for Co-I Hayne
- 2016–2025 *Mars Reconnaissance Orbiter Extended Missions 4–6*
PI: A. Kleinböhl (Co-I: P. Hayne)
NASA Mars Program / ~\$1.5M allocation for Co-I Hayne
- 2019–2024 *Janus Mission*
PI: D. Scheeres (Co-I/Instrument Lead: P. Hayne)
NASA SIMPLEX Program / ~ \$400k subaward to LASP
- 2013–2023 *Lunar Flashlight Science Investigation*
PI: B. Cohen (Co-I: P. Hayne)
NASA Advanced Exploration Systems / ~\$900k allocation for Co-I Hayne
- 2018–2021 *Boulders on Bennu: Modeling Thermal Emission from Boulders for Yarkovsky Effect and Thermal Inertia Investigations*
PI: P. Hayne (Science PI: C. Elder)
NASA OSIRIS-REx Participating Scientist Program / \$346k
- 2017–2018 *Unlocking the Climate Record Stored within Mars’ Polar Layered Deposits*
PI: P. Hayne
W. M. Keck Institute for Space Studies / \$50k

Grants Cont.	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 / \$331k
	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 / ~\$120k
	2014–2016	<i>Thermal Infrared Observations of the Moon during Lunar Eclipse</i> PI: P. Lucey (Co-I: P. Hayne) NASA Planetary Astronomy / \$143k allocation for P. Hayne
	2013–2014	<i>New Approaches to Lunar Ice Detection and Mapping</i> PI: P. Hayne W. M. Keck Institute for Space Studies / \$50k

National Service	Europa ICONS <i>Member</i> of NASA's Program Definition Tiger Team (2023–2024)
	NASA Artemis <i>Course Developer</i> , Astronaut Training – Lunar Surface Environment (2024–present)

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
Editorial Board Member, Icarus (2020–present)
Member of the Federal Relations Subcommittee (2017–2022)
Local Organizing Committee, Annual Meeting (2016)
Panelist, Annual Meeting (2015)

American Geophysical Union
Session Co-organizer (Mars Atmosphere), Annual Meeting (2014–2024)

Early-Career Planetary Explorers
Co-founder (2012) and *Co-leader* (2012–2020)
 World-wide advocacy organization for early-career planetary scientists

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)

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, Nature, PNAS

Departmental & LASP Service	<i>Committee Membership (APS Department):</i>	
	2024/2025	McCray Fellowship Committee
	2024/2025	Sommers-Bausch Observatory/Fiske Planetarium Committee
	2024/2025	Faculty Search Committee
	2024/2025	Graduate Curriculum and Concerns Committee
	2024/2025	Beyond Boulder (Graduate School Info Session)
	2023/2024	Graduate Admissions Committee (Vice Chair)
	2023/2024	Faculty Search Committee
	2023/2024	Social Committee
	2022/2023	Outreach & Development Committee
	2022/2023	Friday Lunch Seminar Committee
	2022/2023	Graduate Admissions Committee (Chair)
	2021/2022	Graduate Admissions Committee
	2021/2022	Faculty Search Committee
	2021/2022	Outreach & Development Committee
	2020/2021	Fall Semester/COVID Planning Committee
	2020/2021	Grad Welcome and Social Committee
	2019/2020	Social Committee (Chair)
	2019/2020	Colloquium Committee
	2019/2020	Undergraduate Curriculum and Concerns Comm.
	2019/2020	Graduate Admissions Committee
	2018/2019	Social Committee (Acting Chair)
	2018/2019	Colloquium Committee

Committee Membership (LASP):

2023–present	LASP Research Scientist promotion committees
2024–2025	LASP Internal Research and Development Committee
2023–2024	LASP Strategic Planning Team

Departmental Mentoring:

2018–present	APS Department Undergraduate Student Mentor
2018–present	APS Department Graduate Student Mentor

Additional Service:

2018-2019	Co-organizer: “Planet Lunch”	CU Boulder
2018-2020	Organizer: Natural Sciences New Faculty Coffee	CU Boulder

Visiting Appointments	Lawrence Livermore National Laboratory
	<i>Visiting Scientist</i> (2017) Planetary Defense Program / Weapons and Complex Integration (WCI)

Weizmann Institute of Science, Israel

<i>Visiting Scientist</i> (2015, 2016)
The Helen Kimmel Center for Planetary Science

Honors & Awards	2022	<i>RIO Faculty Fellow</i> , CU Research & Innovation Office
	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
	2003	<i>Graduate Fellowship</i> , Dept. of Geophysics, Stanford University
	2001	<i>Summer Research Fellowship</i> , Dept. of Physics, Stanford University

Exam Committees & Defenses	<i>Graduate Comprehensive Examinations:</i>		
	2024	James Crowley	CU / APS
	2024	Michael Rothman	CU / APS
	2024	Sam Cartwright	CU / GEOL
	2023	Robert Stevens*	CU / APS *Primary Advisor
	2023	Helle Skjetne	CU / GEOL
	2023	Kris Laferriere	Purdue U.
	2022	Harry Brodsky	CU / GEOL
	2022	Patrick Behr	CU / APS
	2022	Dahlia Baker	CU / AES
	2021	Kya Sorli*	CU / APS *Primary Advisor
	2020	E. Fernando Cruz	CU / APS Non-advocate Chair
	2020	Rachel Hoover	CU / GEOL
	2019	Eryn Cangi	CU / APS
	2019	Noora Alsaeed	CU / APS Non-advocate Chair
	2019	Raven Larson*	CU / APS *Primary Advisor
	2019	Andrew Wilcoski*	CU / APS *Primary Advisor
	2019	Perianne Johnson	CU / APS Non-advocate Chair
	2019	William Waalkes	CU / APS
	2018	Momchil Molnar	CU / APS
	2018	Arika Egan	CU / APS

Ph.D. Dissertation Defenses:

2024	Dr. Koundinya (Ken) Kuppa	CU / AES	
2024	Dr. Lucas Lange	Sorbonne Université / LMD	
2022	Dr. Noora Alsaeed*	CU / APS	*Primary Advisor
2022	Dr. Andrew Wilcoski*	CU / APS	*Primary Advisor
2022	Dr. Chase Chivers	Georgia Tech / EAS	
2022	Dr. Christopher Kremer	Brown U. / DEEPS	
2019	Dr. Marek Slipski	CU / GEOP	

Undergraduate Honors Thesis Defenses:

2019	Carlos Eytan Gary Bicas*	CU / APS	*Primary Advisor
2018	Amanda Alexander	CU / GEOL	

Teaching

University of Colorado Boulder

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

Instructor for undergraduate majors course (115 students)

ASTR 3400: Research Methods (Spring, 2023; Spring, 2024)

Instructor for undergraduate majors course (30 students)

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

Instructor for upper-division undergraduate course (84 students)

ASTR 3750: Planets, Moons, and Rings (Fall, 2020; Fall, 2021; Fall, 2022; Fall, 2024)

Instructor for undergraduate majors course (~100 students)

ASTR 5800: Planetary Surfaces & Interiors (Fall, 2019; Fall, 2021; Fall, 2023)

Instructor for graduate course (~15 students)

ASTR 5830: Remote Sensing of Planetary Surfaces and Atmospheres (Spring, 2025)

Instructor for graduate course (~10 students)

ASTR 5835: Seminar in Planetary Science (Spring, 2023; Fall, 2024)

Co-Instr. for grad. seminar (~25 students): “Asteroids” and “Ocean Worlds”

Teaching (cont.)	California Institute of Technology
	<i>Ge 151: Planetary Surfaces</i> (2011)
	Co-Instructor & Lecturer for graduate course (~6 students)
	University of California, Los Angeles
	<i>ESS 10: Exploring Mars</i> (2008)
	Teaching Assistant and Lecturer for undergraduate course (60 students)
	Stanford University
	<i>Geophysics 150: Physics of the Earth</i> (2004, 2005)
	Teaching Assistant for graduate course (~6 students)
	<i>Physics 50: Observational Astronomy</i> (2002, 2003)
	Teaching Assistant for undergraduate course (~20 students)
Mentoring	Laboratory for Atmospheric and Space Physics
	<i>Postdocs</i>
	2023–present: Dr. Harish
	2022–present: Dr. Patrick O’Brien
	2019–2020: Dr. Margaret Landis (now: faculty member, ASU)
	<i>Graduate Students</i>
	2023–present: Heshani Pieris (APS Dept., U. Colorado)
	2022–present: Robert Stevens (APS Dept., U. Colorado)
	2020–present: Kya Sorli (APS Dept., U. Colorado) *NSF Fellow
	2020–2022: Noora Alsaeed, Ph.D. — <i>Dec. ‘22</i> (APS Dept., U. Colorado)
	2018–2022: Andrew Wilcoski, Ph.D. — <i>Dec. ‘22</i> (APS Dept., U. Colorado)
	2019–2020: Raven Larson, M.S. — <i>May ‘20</i> (APS Dept., U. Colorado)
	<i>Undergraduate Students</i>
	2024–present: Maya Nussbaumer (APS Dept., CU Boulder)
	2024 (summer): Matthew Perkins (NASA Europa ICONS)
	2023 (summer): Fahad Alawadhi (AES Dept., CU Boulder)
	2023 (summer): Alia Almansoori (U. Edinburgh)
	2023 (summer): Tyler Jx Bellison (Fort Lewis College)
	2022–2024: Isabella Wise (APS Dept., CU Boulder)
	2022–2023: Sam Aberbook (Physics Dept., CU Boulder)
	2018–2021: Tara Tomlinson (CU Boulder, B.S. → Dartmouth College, Ph.D.)
	2019–2020: 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 (now: JPL Technologist)
	2016–2018: Dr. Catherine M. Elder (now: JPL Scientist)

Invited
Lectures

2024 L'Space / Arizona State University
 2023 Brown University (postponed)
 2021 Purdue University
 2020 Planetary Science Decadal Survey
 2020 Observatoire de la Côte d'Azur
 2020 NASA Lunar Surface Science Workshop
 2019 University of California, Los Angeles
 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

Outreach
& Public
Engagement

CU Outreach Grant

Faculty Award Co-Recipient, “Engaging Underserved Students with
CU’s Cutting-edge Space Research” (2021–2022)

Ad Astra Academy

Co-founder and Co-leader, 2015–present

Brazil (2015, 2017), Kenya (2016), Colorado (2021, 2024)

Science and exploration program for underserved student populations

Media Interviews
& Popular Writing

Space.com: [Sunny days on Mars come with a weather warning](#) (Dec. 2024)

Also reported in: *Forbes* and other media outlets

The Conversation: [Scientists suspect there’s ice hiding on the Moon](#) (Nov. 2023)

Reprinted in: *5 Essential Reads on Modern Lunar Missions* (Dec. 2023)

Popular Science: [We finally have a detailed map of water on the moon](#) (Mar. 2023)

The Atlantic: [It snows on Mars](#) (Jan. 2023)

Science Daily: [... Sweater weather on the Moon](#) (Jul. 2022)

The Conversation: [A rocket crashes into the Moon](#) (Mar. 2022)

Space.com: [How a rocket crash on the Moon will help impact physics](#) (Mar. 2022)

CNN: [Ancient volcanoes ... a rare resource for lunar explorers](#) (May 2022)

Wired: [A clever way to map the Moon’s surface: using shadows](#) (Oct. 2022)

The New York Times: [Life on the planet Mercury?](#) (Mar. 2020)

Smithsonian: [The Moon has more hidden water](#) (Oct 2020)

Popular Science: [Europa is the new Mars](#) (Jun. 2013)

Quirks & Quarks (podcast interview):

[The Moon’s a wetter place than we thought](#) (Oct. 2020)

AirTalk (radio interview):

[Studies confirm longstanding theory that there’s water on the Moon](#) (Oct. 2020)

Professional Affiliations	American Astronomical Society - Division for Planetary Sciences American Geophysical Union European Geosciences Union Asia Oceania Geosciences Society
Skills & Training	Remote sensing & spacecraft instrumentation, Modeling and numerical simulation Computer programming languages Proficient/expert: C/C++, Python, MATLAB, IDL Familiar: Fortran 90/95, shell scripting, etc. Mission formulation experience <i>Team-X</i>, NASA Jet Propulsion Laboratory <i>Team-A</i>, NASA Jet Propulsion Laboratory <i>Capture Lead Training</i>, NASA Jet Propulsion Laboratory Co-I and Deputy PI on mission proposals to NASA's <i>Discovery</i> and <i>New Frontiers</i> Successful PI on multiple instrument proposals to NASA mission programs Additional training <i>NASA Astrobiology Winter School and Field Course</i> (2011) <i>International Astrobiology Summer School</i> (2008) <i>PADI Open Water Diver</i> scuba certification (50+ dives) <i>Eagle Scout</i> (1998), BSA Troop 676, Issaquah, WA

Publications: Refereed Journal Articles

Number of peer-reviewed publications: 96 (as of January, 2025)

First-author: 10 / Student-supervised first-author: 14 / Postdoc-supervised first-author: 9

h-index: 31 ([ADS](#)), 35 ([Google Scholar](#))

i100-index (# papers cited ≥ 100 times): 17 (6 as first-author)

Total citations: 4,088 (ADS), 6,089 (Google Scholar)

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

See next page.

1. ^{*}(G) **Alsaeed, N. R., Hayne, P. O.,** & Concepcion, V. (2024), Seasonal and inter-annual variability in the polar vortex and snowfall on Mars, *J. Geophys. Res.*, *129*(12), e2024JE008397.
2. Gallinger, C. L., Williams, J-P., Neish, C. D., Powell, T. M., Elder, C. M., Ghent, R. R., **Hayne, P. O.,** & Paige, D. A. (2024), Thermophysical Diversity of Young Lunar Crater Ejecta Revealed with LRO Diviner Observations, *Planet. Sci. J.*, *5*(11), 261.
3. O'Brien, P., Scully, J. E. C., ^{*}(P) **Landis, M. E.,** Schörghofer, N., **Hayne, P. O.** (2024), Enhancement of the Cerean Exosphere by Sublimation from Complex Craters, *Planet. Sci. J.*, *5*(9), 199.
4. Cohen, B. A., Petersburg, R. R., Cremons, D. R., Russell, P. S., **Hayne, P. O.,** Greenhagen, B. T., Paige, D. A., et al. (2024), Lunar Flashlight science ground and flight measurements and operations using a multi-band laser reflectometer, *Icarus*, *413*, 116013.
5. Hoover, R. H., Robbins, S. J., Hynek, B. M., & **Hayne, P. O.** (2024), Depth-to-diameter Ratios of Fresh Craters on the Moon and Implications for Surface Age Estimates, *Planet. Sci. J.*, *5*(1), 26.
6. ^{*}(P) **Landis, M. E.,** Dundas, C. M., McEwen, A. S., Daubar, I. J., **Hayne, P. O.,** Byrne, S., et al. (2024), New, dated small impacts on the South Polar Layered Deposits (SPLD), Mars, and implications for shallow subsurface properties, *Icarus*, 115977.
7. ^{*}(U) **Bürger, J., Hayne, P. O.,** Gundlach, B., Läufer, M., Kramer, T., & Blum, J. (2024), A microphysical thermal model for the lunar regolith: Investigating the latitudinal dependence of regolith properties, *J. Geophys. Res.*, *129*(3), e2023JE008152.
8. Daubar, I. J., Hayes, A. G., Collins, G. C., Craft, K. L., Rathbun, J. A., Spencer, J. R., ... **Hayne, P. O.,** et al. (2024), Planned geological investigations of the Europa Clipper Mission, *Space Sci. Rev.*, *220*(1), 18.
9. Piqueux, S., Kass, D. M., Kleinböhl, A., Slipski, M., **Hayne, P. O.,** McCleese, D. J., Schofield, J. T., & Heavens, N. (2024), Mars thermal inertia and surface temperatures by the Mars Climate Sounder, *Icarus*, *419*, 115851.
10. Christensen, P. R., Spencer, J. R., Mehall, G. L., Patel, M., ... **Hayne, P. O.,** et al. (2024), The Europa Thermal Emission Imaging System (E-THEMIS) Investigation for the Europa Clipper Mission, *Space Sci. Rev.*, *220*(4), 1-65.

11. ^{*}(P) Burnett, E. R., & Hayne, P. O. (2023) Spin-orbit coupling of Europa’s ice shell and interior, *Icarus*, 406, doi: [10.1016/j.icarus.2023.115731](https://doi.org/10.1016/j.icarus.2023.115731).
12. Elder, C. M., Ghent, R. R., Haber, J., Hayne, P. O., et al. (2023), The variability of lunar mare basalt properties from surface rock abundance, *Planet. Sci. J.*, 4(12), 244, doi: [10.3847/PSJ/ad06a8](https://doi.org/10.3847/PSJ/ad06a8).
13. ^{*}(G) Wilcoski, A. X., Hayne, P. O., & Elder, C. M. (2023) Thermal environments and volatile stability within lunar pits and caves, *J. Geophys. Res.*, e2023JE007758. doi: [10.1029/2023JE007758](https://doi.org/10.1029/2023JE007758)
14. Osinski, G. R., Melosh, H. J., ..., Hayne, P. O., et al. (2023), Lunar impact features and processes, *Reviews in Mineralogy and Geochemistry*, 89(1), 651–690, doi: [10.2138/rmg.2023.89.08](https://doi.org/10.2138/rmg.2023.89.08).
15. Plescia, J. B., Cahill, J., ..., Hayne, P. O., et al. (2023), Lunar surface processes, *Reviews in Mineralogy and Geochemistry*, 89(1), 651–690, doi: [10.2138/rmg.2023.89.15](https://doi.org/10.2138/rmg.2023.89.15).
16. Hurley, D. M., Siegler, M. A., ..., Hayne, P. O., et al. (2023), Surface volatiles on the Moon, *Reviews in Mineralogy and Geochemistry*, 89(1), 787–827, doi: [10.2138/rmg.2023.89.18](https://doi.org/10.2138/rmg.2023.89.18).
17. Byron, B. D., Elder, C., ..., Hayne, P. O., et al. (2023), Evidence for fine-grained material at lunar red spots: Insights from thermal infrared and radar data sets, *Planet. Sci. J.*, 4(9), 182, doi: [10.3847/PSJ/acf134](https://doi.org/10.3847/PSJ/acf134).
18. Hansen, C. J., Byrne, S., Calvin, W. M., Diniega, S., Dundas, C. M., Hayne, P. O., et al. (2023), A comparison of CO₂ seasonal activity in Mars’ northern and southern hemispheres, *Icarus*, in press, doi: [10.1016/j.icarus.2023.115801](https://doi.org/10.1016/j.icarus.2023.115801)
19. Roberts, J. H., McKinnon, W. B., ..., Hayne, P. O., et al. (2023), Exploring the interior of Europa with the Europa Clipper, *Space Sci. Rev.*, 219(6), 46, doi: [10.1007/s11214-023-00990-y](https://doi.org/10.1007/s11214-023-00990-y).
20. Magaña, L. O., Retherford, K. D., ..., Hayne, P. O., et al. (2023), LRO-LAMP lunar south pole cold traps: Assessment of H₂O and potential CO₂ and NH₃ reserves, *J. Geophys. Res.*, 128, 8, e2023JE007863, doi: [10.1029/2023JE007863](https://doi.org/10.1029/2023JE007863).
21. Nesnas, I. A. D., Kerber, L., ..., Hayne, P., et al. (2023), Moon Diver: Exploring a Pit’s exposed strata to understand lunar volcanism, *Acta Astronautica*, 211, 163–176, doi: [10.1016/j.actaastro.2023.05.042](https://doi.org/10.1016/j.actaastro.2023.05.042).
22. Piqueux, S., Hayne, P. O., Kleinböhl, A., Kass, D. M., Schreier, M., McCleese, D. J., ... & Shirley, J. H. (2023), Atmospheric CO₂ depletion near the surface in the martian polar regions, *J. Geophys. Res.*, e2022JE007386. doi: [10.1029/2022JE007332](https://doi.org/10.1029/2022JE007332)
23. Powell, T. M., Horvath, T., Robles, V. L., Williams, J. P., Hayne, P. O., Gallinger, C. L., ... & Paige, D. A. (2023), High-resolution nighttime temperature and rock abundance mapping of the Moon using the Diviner Lunar Radiometer Experiment with a model for topographic removal, *J. Geophys. Res.*, 128(2), e2022JE007532. doi: [10.1029/2022JE007532](https://doi.org/10.1029/2022JE007532)

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