

Kenneth Hart Williford

Curriculum Vitae

Blue Marble Space

ken@bmsis.org | mobile: +1 206 484 3971

kenwilliford.net | github.com/kenwilliford

Education

2007: Ph.D., Earth and Space Sciences (certificate in Astrobiology)

University of Washington, Seattle, WA

Biogeochemistry of the Triassic–Jurassic boundary

2000: M.S., Geological Sciences, University of Washington, Seattle, WA

Strontium/calcium thermometry in the Caribbean reef coral *Siderastrea siderea*

1998: B.S., Natural Resources cum laude University of the South, Sewanee, TN

Continuing Education

2024: Professional Certificate, Data Science and Analytics

Massachusetts Institute of Technology, Cambridge, MA

Professional Experience

2021–present: Research Investigator, Blue Marble Space

2014–present: Co-Investigator, SHERLOC instrument, NASA Mars 2020 rover mission

2014–2021: Deputy Project Scientist, NASA Mars 2020 Perseverance rover mission

2013–2021: Visiting Associate, Division of Geological and Planetary Sciences, Caltech, Pasadena, CA

2012–2021: Founding Director, JPL Astrobiogeochemistry Laboratory (abcLab)

2012–2021: Research Scientist, Jet Propulsion Laboratory, Pasadena, CA

2013–2014: Surface Sampling System Scientist, NASA Mars Science Laboratory Curiosity rover mission

2014–2016: Collaborator, Sample Analysis at Mars instrument, NASA Mars Science Laboratory mission

2013–2016: Science Team Member, NASA Mars Science Laboratory mission

2010–2012: Research Associate, Dept of Geoscience, University of Wisconsin, Madison, WI

2007–2009: Research Associate, Dept of Chemistry, Curtin University, Perth, Western Australia

2005–2007: NSF IGERT Fellow, University of Washington Astrobiology Program

2003–2005: Research Assistant, Dept of Earth and Space Sciences, Univ of Washington

2002–2003: Information Architect, Verisign Inc., Savannah, GA

2001: Geologist, Hall, Blake & Associates, Nashville, TN

2000–2001: Earth science, life science and math teacher: Good Hope School, St. Croix, USVI

1998–2000: Teaching Assistant, Dept of Geological Sciences, University of Washington

Teaching

2000–2001: Good Hope School, St. Croix, USVI: Earth science, life science and mathematics

1998–2000: University of Washington: Geobiology (x2), Invertebrate Paleontology (x2), Dinosaurs, Geology 101

Student Supervision

2026: Jesús Rodríguez, B.S. Universidad Popular Autónoma del Estado de Puebla

2019–2023: Emilia Hernandez, Ph.D., University of California Davis

2017–2020: Kelsey Moore, Ph.D., Massachusetts Institute of Technology

2014–2021: Jeffery Osterhout, M.S. University of Cincinnati, Ph.D. UCLA

2013–2021: Adam Hoffman, Ph.D. candidate, University of California Riverside

2015–2017: Amanda Allen, undergraduate intern, Santa Barbara City College

2017–2018: Joyce Yager, Ph.D., University of Southern California

2017–2018: Peter Wynn, undergraduate, University of Southern California

2016–2018: Ashley Berg, Ph.D. University of Tennessee

2015: Lorenia Alejandra, undergraduate intern, Santa Ana College

2014–2016: Katrine Hansen, Ph.D. candidate, University of Copenhagen

2016: Brandy Coats, undergraduate intern, University of California–Riverside
2016: Erica Gaspari, undergraduate intern, Montana State University
2016: Meika Nwaomah, STAR teacher intern
2015: Ellie Hara, undergraduate intern, University of Southern California
2015: Emily Ross, undergraduate intern, Carleton College
2015: Kari Finstad, Ph.D. candidate, University of California, Berkeley
2014: Kira Lorber, Ph.D. candidate, University of Cincinnati
2014: Jorge Orbay, undergraduate intern, Columbia University
2014: Isis Frausto-Vicencio, undergraduate intern, UCLA
2014: Emily Meany, undergraduate intern, Caltech
2008-2009: Salem Aboglila, Ph.D., Department of Applied Chemistry, Curtin University

Professional Societies

2005–present: Geological Society of America
2011–present: American Geophysical Union
2011–present: Geochemical Society

Selected Outreach and Service

2024: Certified Hospice Volunteer, Providence Hospice, Seattle
2020: NASA Infiniscope, educating LAUSD teachers in Earth and Planetary Science
2017: Von Karman Lecture, [Mars 2020, or There and Back Again](#)
2015-2017: Technical advisory board, Boundaries of Life Initiative, Templeton Foundation
2014: Donald Foster Hewett Seminar Series on The Origin of Life, Lehigh University
2014-present: Editorial Advisory Board, Geobiology
2012: Explore: Life on Mars program, Madison, WI
2011: Imagine Mars: 6 week NASA/NEA program with Akira Toki Middle School, Madison, WI
2011: Astrobiology in Your Back Yard: outreach stations in Madison, WI
2010: Astrobiology night at the ballpark with the Madison Mallards
2008: Contributor to the Animal Planet television program entitled “Animal Armageddon”
2008: Field program on Archean stromatolites with indigenous Australian students from Marble Bar, Australia
2007: Created “Discover Smoke Farm,” BioBlitz and biodiversity education for Seattle elementary students
2007: Contributor to the History Channel television program “How Life Began” at Walcott Quarry
2006: Graduate student representative to Astrobiology faculty search committee, University of Washington
2005: Curriculum committee, Department of Earth and Space Sciences, University of Washington
2005: Invited speaker, Northwest Geological Society
2004-2007: Project AstroBio: astrobiology-themed outreach with Seattle school teachers

Peer-Reviewed Publications

Bykov, S.V., Williford, K.H. and 25 others, 2026. In situ detection of opal-A in Jezero Crater, Mars. *Journal of Geophysical Research: Planets* 131: e2025JE009375. [doi:10.1029/2025JE009375](https://doi.org/10.1029/2025JE009375)

Haney, N.C. and 22 others including Williford, K.H., 2026. Multidisciplinary analyses of terrestrial samples used to interpret an inorganic origin (anhydrite:Ce³⁺) for the 304 and 325-nm doublet fluorescence detected by the Mars 2020 SHERLOC instrument at Jezero Crater. *Journal of Geophysical Research: Planets* 131: e2025JE009385. [doi:10.1029/2025JE009385](https://doi.org/10.1029/2025JE009385)

Blattman, F.R. and 11 others including Williford, K.H., 2026. Domed-rim microbial polygons and their preservation potential. *The Depositional Record* 12: e70061. [doi:10.1002/dep2.70061](https://doi.org/10.1002/dep2.70061)

Jones, A.A. and 29 others including Williford, K.H., 2026. Stratigraphy of Carbonate-Bearing Rocks at the Margin of Jezero Crater, Mars: Evidence for Shoreline Processes? *Journal of Geophysical Research – Planets* 131: e2025JE009111. [doi:10.1029/2025JE009111](https://doi.org/10.1029/2025JE009111)

Williford, K.H. and 74 others. 2026. Carbonated ultramafic igneous rocks in Jezero crater, Mars. *Science* 391: eadu8264. [doi:10.1126/science.adu8264](https://doi.org/10.1126/science.adu8264)

Hurowitz, J.A. and 88 others including Williford, K.H., 2025. Redox-driven mineral and organic associations in Jezero Crater, Mars. *Nature* 645. [doi:10.1038/s41586-025-09413-0](https://doi.org/10.1038/s41586-025-09413-0)

- Hausrath, E.M. and 65 others including Williford, K.H., 2025. Collection and in situ analyses of regolith samples by the Mars 2020 rover: Implications for their formation and alteration history. *Journal of Geophysical Research – Planets* 130: e2023JE008046. doi:10.1029/2023JE008046
- Figuroa, M.C., Gregory, D.D., Williford, K.H., Fike, D.J., Lyons, T.W., 2024. A machine learning approach to biosignature exploration on Early Earth and Mars using sulfur isotope and trace element data in pyrite. *Astrobiology* 24: 1110-1127. doi:10.1089/ast.2024.0019
- Scheller, E.L. and 33 others including Williford, K.H., 2024. Inorganic interpretation of luminescent materials encountered by the Perseverance rover on Mars. *Science Advances* 10: eadm8241. doi:10.1126/sciadv.adm8241
- Phua, U.U. and 22 others including Williford, K.H., 2024. Characterizing hydrated sulfates and altered phases in Jezero Crater fan and floor geologic units with SHERLOC on Mars 2020. *Journal of Geophysical Research: Planets* 129: e2023JE008251. doi:10.1029/2023JE008251
- Bosak, T. and 66 others including Williford, K.H., 2024. Astrobiological potential of rocks acquired by the Perseverance rover at a sedimentary fan front in Jezero crater, Mars. *AGU Advances* 5: e2024AV001241. doi:10.1029/2024AV001241
- Weiss, B.P. and 23 others including Williford, K.H., 2024. Oriented bedrock samples drilled by the Perseverance rover on Mars. *Earth and Space Science* 11 e2023EA003322. doi:10.1029/2023EA003322
- Siljeström, S., and 55 others including Williford, K.H., 2024. Evidence of sulfate-rich fluid alteration in Jezero crater floor, Mars. *Journal of Geophysical Research: Planets* 129: e2023JE007989. doi:10.1029/2023JE007989
- Simon, J.I., and 67 others including Williford, K.H., 2023. Samples collected from the floor of Jezero Crater with the Mars 2020 Perseverance Rover. *Journal of Geophysical Research: Planets* 128: e2022JE007474. doi:10.1029/2022JE007474
- Scheller, E.L. and 65 others including Williford, K.H., 2022. Aqueous alteration processes in Jezero crater, Mars – implications for organic geochemistry. *Science* 378: 1105-1110. doi:10.1126/science.abo5204
- Moore, K.R., Daye, M., Gong, J., Williford, K.H., Bosak, T., 2022. A review of microbial-environmental interactions recorded in Proterozoic carbonate-hosted chert. *Geobiology* 21: 3-27. doi:10.1111/gbi.12527
- Osterhout, J.T., Schopf, J.W., Kudryavstev, A.B., Czaja, A.D., Williford, K.H., 2022. Deep-UV Raman spectroscopy of carbonaceous Precambrian microfossils: Insights into the search for past life on Mars. *Astrobiology* 22: 1239-1254. doi:10.1089/ast.2021.0135
- Farley, K.A. and 113 others including Williford, K.H., 2022. Aqueously altered igneous rocks sampled on the floor of Jezero crater, Mars. *Science* 377: abo2196. doi:10.1126/science.abo2196
- Liu, Y. and 70 others including Williford, K.H., 2022. An olivine cumulate outcrop on the floor of Jezero crater, Mars. *Science* 377: 1513-1519. doi:10.1126/science.abo2756
- Wiens, R.C. and 93 others including Williford, K.H., 2022. Compositionally and density stratified igneous terrain in Jezero crater, Mars. *Science Advances* 8: eabo3399. doi:10.1126/sciadv.abo3399
- Moore, K.R., Present, T.M., Pavia, F., Grotzinger, J.P., Razzell-Hollis, J., Sharma, S., Flannery, D., Bosak, T., Tuite, M., Knoll, A.H., Williford, K.H., 2022. Biosignature preservation aided by organic-cation interactions in Proterozoic tidal environments. *Palaios* 37: 486-498. doi:10.2110/palo.2022.017
- Maurice, S. and 41 others including Williford, K.H., 2022. In situ recording of Mars soundscape. *Nature* 605: 653-658. doi:10.1038/s41586-022-04679-0
- Changela, H.G. and 38 others including Williford, K.H., 2022. Mars: new insights and unresolved questions. *International Journal of Astrobiology* 20: 394-426. doi:10.1017/S1473550421000276
- Mangold, N., Gupta, S., Gasnault, O., Dromart, G., Tarnas, J.D., Sholes, S.F., Horgan, B., Quantin-Nataf, C., Brown, A.J., Le Mouélic, S., Yingst, R.A., Bell, J.F., Beyssac, O., Bosak, T., Calef, F. III, Ehlmann, B.L., Farley, K.A., Grotzinger, J.P., Hickman-Lewis, K., Holm-Alwmark, S., Kah, L.C., Martinez-Frias, J., McLennan, S.M., Maurice, S., Nuñez, J.I., Ollila, A.M., Pilleri, P., Rice Jr., J.W., Rice, M., Simon, J.I., Schuster, D.L., Stack, K.M., Sun, V.Z., Treiman, A.H., Weiss, B.P., Wiens, R.C., Williams, A.J., Williams, N.R., Williford, K.H., 2021. Perseverance rover reveals an ancient delta-lake system and flood deposits at Jezero crater, Mars. *Science* 374: 711-717. doi:10.1126/science.abl4051
- Aramendia, J., Gomez-Nubla, L., Tuite, M.L., Williford, K.H., Madariaga, J.M., 2021. A new semi-quantitative surface-enhanced raman spectroscopy method for detection of maleimide (2, 5-pyrroledione) with potential application to astrobiology. *Geoscience Frontiers* 12: 101226. doi:10.1016/j.gsf.2021.101226
- Osterhout, J.T., Schopf, J.W., Williford, K.H., McKeegan, K.D., Kudryavstev, A.B., Liu, M., 2021. Carbon isotopes of Proterozoic filamentous microfossils: SIMS analyses of ancient cyanobacteria from two disparate shallow-marine cherts. *Geomicrobiology Journal* 38: 719-731. doi:10.1080/01490451.2021.1939813

- Moore, K.R., Gong, J., Pajusalu, M., Skoog, E.J., Xu, M., Soto, T.F., Sojo, V., Matreux, T., Baldes, M.J., Braun, D., Williford, K.H., Bosak, T., 2021. A new model for silicification of cyanobacteria in Proterozoic tidal flats. *Geobiology* 19: 438-449. doi:10.1111/gbi.12447
- Bhartia, R. and 97 others including Williford, K.H., 2021. Perseverance's Scanning Habitable Environments with Raman and Luminescence for Organics and Chemicals (SHERLOC) investigation. *Space Science Reviews* 217: 1-115. doi:10.1007/s11214-021-00812-z
- Farley, K.A., Williford, K.H., Stack, K.M., and 27 others, 2020. Mars 2020 Mission Overview. *Space Science Reviews* 216: 142. doi:10.1007/s11214-020-00762-y
- Stack, K.M., Williams, N.R., Calef, F. III, Sun, V.Z., Williford, K.H., Farley, K.A., and 61 others, 2020. Photogeologic map of the Perseverance rover field site in Jezero crater constructed by the Mars 2020 Science Team. *Space Science Reviews* 216: 127. doi:10.1007/s11214-020-00739-x
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- Alleon, J., Flannery, D.T., Ferralis, N., Williford, K.H., Zhang, Y., Schuessler, J.A., Summons, R.E., 2019. Organo-mineral associations in chert of the 3.5 Mount Ada Basalt raise questions about the origin of organic matter in Paleoproterozoic hydrothermally influenced sediments. *Scientific Reports* 9: 16712. doi:10.1038/s41598-019-53272-5
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- Tuite, M.L., Williford, K.H., Macko, S.A., 2019. From greenhouse to icehouse: Nitrogen biogeochemistry of an epeiric sea in the context of the oxygenation of the Late Devonian atmosphere/ocean system. *Palaeogeography, Palaeoclimatology, Palaeoecology* 531: 109204. doi:10.1016/j.palaeo.2019.05.026
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- Osinski, G.R. et al., 2019. The CanMars Mars Sample Return Analogue Mission. *Planetary and Space Science* 166: 110-130. doi:10.1016/j.pss.2018.07.011
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- Pilles, E.A., Cross, M., Caudill, C.M., Francis, R., Osinski, G.R., Newman, J., Battler, M., Bourassa, M., Haltigin, T., Hipkin, V., Kerrigan, M., McLennan, S., Silber, E.A., Williford, K., 2019. Exploring new models for improving planetary rover operations efficiency through the 2016 CanMars Mars Sample Return (MSR) analogue deployment. *Planetary and Space Science* 165: 250-259. doi:10.1016/j.pss.2018.10.001
- Manning-Berg, A.R., Wood, R.S., Williford, K.H., Czaja, A.D., Kah, L.C., 2019. The taphonomy of Proterozoic microbial mats and implications for early diagenetic silicification. *Geosciences* 9: 40. doi:10.3390/geosciences9010040
- Lepot, K., Williford, K.H., Philippot, P., Thomazo, C., Ushikubo, T., Kitajima, K., Mostefaoui, S., Valley, J.W., 2019. Extreme ^{13}C -depletions and organic sulfur content argue for S-fueled anaerobic methane oxidation in 2.72 Ga old stromatolites. *Geochimica et Cosmochimica Acta* 244: 522-547. doi:10.1016/j.gca.2018.10.014
- Williford, K.H., K.A. Farley, K.M. Stack, A.C. Allwood, D. Beaty, L. Beegle, R. Bhartia, A.J. Brown, M. de la Torre Juarez, S.-E. Hamran, M.H. Hecht, J. Hurowitz, J.A. Rodriguez-Manfredi, S. Maurice, S. Milkovich, R.C. Wiens, 2018. The NASA Mars 2020 rover mission and the search for extraterrestrial life. In: *From Habitability to Life on Mars*, Cabrol, N.A., and E.A. Grin, eds., p. 275-308, Elsevier. doi:10.1016/B978-0-12-809935-3.00010-4
- Grant, J., Golombek, M., Wilson, S., Farley, K., Williford, K., Chen, A., 2018. The science process for selecting the landing site for the 2020 Mars rover. *Planetary and Space Science* 164: 106-126. doi:10.1016/j.pss.2018.07.001
- Finstad, K.M., Pfeiffer, M., McNicol, G., Tuite, M., Williford, K.H., Amundson, R., 2018. A late Quaternary

- paleoenvironmental record in sand dunes of the northern Atacama Desert, Chile. *Quaternary Research* 90: 127-138. doi:10.1017/qua.2018.20
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- McMahon, S., Bosak, T., Grotzinger, J., Milliken, R., Summons, R., Daye, M., Newman, S., Fraeman, A., Williford, K.H., Briggs, D., 2018. A field guide to finding fossils on Mars. *Journal of Geophysical Research: Planets* 123: 1012-1040. doi:10.1029/2017JE005478
- Flannery, D., Allwood, A.C., Summons, R.E., Williford, K.H., Abbey, W., Matys, E.D., Ferralis, N., 2018. Spatially-resolved isotopic study of carbon trapped in ~3.43 Ga Strelley Pool Formation stromatolites. *Geochimica et Cosmochimica Acta* 223: 21-35. doi:10.1016/j.gca.2017.11.028
- Schopf, J.W., Kudryavstev, A.B., Osterhout, J.T., Williford, K.H., Kitajima, K., Valley, J.W., Sugitani, K., 2017. An aerobic similar to 3400 Ma shallow-water microbial consortium: Presumptive evidence of Earth's Paleoproterozoic anoxic atmosphere. *Precambrian Research* 299: 309-318. doi:10.1016/j.precamres.2017.07.021
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- Schoepfer, S.D., Algeo, T.J., Ward, P.D., Williford, K.H., Haggart, J.W., 2016. Testing the limits in a greenhouse ocean: Did low nitrogen availability limit marine productivity during the end-Triassic mass extinction? *EPSL* 451: 138-148. doi:10.1016/j.epsl.2016.06.050
- Haddad, E.E., Tuite, M.L., Martinez, A.M., Williford, K.H., Boyer, D.L., Droser, M.L., Love, G.D., 2016. Lipid biomarker stratigraphic records through the Late Devonian Frasnian/Famennian boundary: Comparison of high- and low-latitude epicontinental marine settings. *Organic Geochemistry* 98: 38-53. doi:10.1016/j.orggeochem.2016.05.007
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- Morag, N., Williford, K.H., Kitajima, K., Philippot, P., Van Kranendonk, M.J., Lepot, K., Thomazo, C., Valley, J.W., 2016. Microstructure-specific carbon isotopic signatures of organic matter from ~3.5 Ga cherts of the Pilbara Craton support a biologic origin. *Precambrian Research* 275: 429-449. doi:10.1016/j.precamres.2016.01.014
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- in situ sulfur four-isotope analysis with multiple Faraday cup detectors by SIMS and application to pyrite grains in a Paleoproterozoic glaciogenic sandstone. *Chemical Geology* 383: 86-99. doi:10.1016/j.chemgeo.2014.06.006
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- Srivastava, A. and 27 others including Williford, K.H., 2025. In situ observation of hydrated carbonate in Jezero Crater, Mars. *LPI Contributions* 3090, 1595.
- Haney, N.C. and 22 others including Williford, K.H., 2025. Multidisciplinary Analyses of Terrestrial Volcanogenic Samples Used to Interpret an Inorganic Origin (Anhydrite:Ce3+) for the 304&325-nm Doublet Detected by the Mars 2020 SHERLOC Instrument. *LPI Contributions* 3090, 2688.

- Uckert, K. and 51 others including Williford, K.H., 2025. Jezero crater rim: initial textural observations and compositional analyses from the SHERLOC deep UV Raman and fluorescence spectrometer. LPI Contributions 3090, 2369.
- Broz, A.P. and 39 others including Williford, K.H., 2025. Green reduction spots in red beds of the Bright Angel Formation, Jezero Crater, Mars and implications for biosignature preservation potential. LPI Contributions 3090, 1706.
- Murphy, A.E. and 66 others including Williford, K.H., 2025. Spatially resolved complex organic matter detected in an ancient river valley in Jezero crater, Mars. LPI Contributions 3090, 2241.
- Williford, K.H., 2023 (invited). How does the record of life on Earth inform the search for ancient life on Mars? American Astronomical Society Meeting Abstracts 55: 317.01.
- Scheller, E.L., and 21 others including Williford, K.H., 2023. Investigating the origin of luminescent materials in the crater floor and delta of Jezero crater, Mars. American Geophysical Union Fall Meeting 2023. P41E-3225.
- Phua, Y.Y., and 19 others including Williford, K.H., 2023. Sulfates as hydration carrier phases in altered rocks of Jezero crater fan and floor geologic units from SHERLOC on Mars 2020. American Geophysical Union Fall Meeting 2023. P51B-05.
- Hurowitz, J.A. and 34 others including Williford, K.H., 2023. Provenance and diagenesis of martian sedimentary rocks in the Jezero crater delta front from microscale observations by the Mars 2020 PIXL instrument. Goldschmidt 2023.
- Hurowitz, J.A. and 34 others including Williford, K.H., 2023. The petrogenic history of the Jezero crater delta front from microscale observations by the Mars 2020 PIXL instrument. 54th Lunar and Planetary Science Conference.
- Clavé, E. and 10 others including Williford, K.H., 2023. Interpreting the continuum signal in the Raman spectra acquired with SuperCam in Jezero crater, Mars. LPI Contributions 2806.
- Roppel, R.D. and 15 others including Williford, K.H., 2023. Investigation of mineralogies during the delta front campaign by SHERLOC. LPI Contributions 2806.
- Scheller, E.L. and 12 others including Williford, K.H., 2022. SHERLOC investigations of the Jezero delta reveals preservation of organic compounds. American Geophysical Union Fall Meeting. P55A-02.
- Weiss, B.P. and 18 others including Williford, K.H., 2022. Orienting rock cores on Mars drilled by the Perseverance rover for martian paleomagnetism studies. American Geophysical Union Fall Meeting. GP36A-07.
- Beegle, L. and 35 others including Williford, K.H., 2022. SHERLOC: Results of the first 350 sols of operations. COSPAR 2022 (Athens).
- Beegle, L. and 34 others including Williford, K.H., 2022. SHERLOC investigation at the Máaz and Séítah Formations within Jezero crater. 2022 Astrobiology Science Conference.
- Mangold, N. and 37 others including Williford, K.H., 2022. Significance of the variations in fluvial input within Jezero crater from Perseverance rover observations. 53rd Lunar and Planetary Science Conference.
- Gupta, S., and 40 others including Williford, K.H., 2022. A delta-lake system at Jezero crater (Mars) from long distance observations. 53rd Lunar and Planetary Science Conference.
- Tzanetos, T., and 25 others including Williford, K.H., 2022. Ingenuity Mars Helicopter: From technology demonstration to extraterrestrial scout. 2022 IEEE Aerospace Conference.
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- Beegle, L.W. and 50 others including Williford, K.H., 2021. An overview of SHERLOC Raman and fluorescence spectroscopy results obtained during Perseverance's Green Zone Campaign at Jezero crater, Mars. American Geophysical Union Fall Meeting 2021.
- Mangold, N. and 38 others including Williford, K.H., 2021. Observations of the Jezero crater delta front by Perseverance cameras. American Geophysical Union Fall Meeting 2021.
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- Herd, C.D.K. and 14 others (including Williford, K.H.), 2021. The Plan for Sampling: Perseverance Rover Notional Caches for Mars Sample Return. American Geophysical Union Fall Meeting 2021.
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