Emmy B. Hughes

PhD Candidate | Georgia Institute of Technology
Email: ehughes36@gatech.edu | ORCID ID: 0000-0001-6848-5524
Georgia Tech | School of Earth & Atmospheric Sciences | 311 Ferst Drive, Atlanta, GA 30332-0340

Education

2021 – Present	**Ph.D. student, Earth & Atmospheric Sciences, Georgia Institute of Technology** Advisors: Dr. James Wray; Dr. Frances Rivera-Hernández
2016 – 2020	**B.A. Earth and Environmental Sciences; English, Wesleyan University** High Honors in Earth and Environmental Sciences; Thesis Advisor: Dr. Martha Gilmore

Research Interests

Martian mineralogy and geochemistry, particularly that of salts, as related to planetary habitability and environmental reconstruction; analogue work in Mars rover-relevant environments; instrumentation development/calibration for Mars missions.

Academic/Research Positions

2024 – Present	Student Employee, Los Alamos National Laboratory, USA
2022 – Present	Graduate Research Assistant, Georgia Institute of Technology, USA
2021 – 2022	Graduate Teaching Assistant, Georgia Institute of Technology, USA
2020 – 2021	Research Assistant, Louisiana State University, USA

NASA Mission Experience

2022 – Present	Student Collaborator, Mars Science Laboratory *Curiosity* rover Activities: Science Operations as ChemCam Downlink Lead (PDL); Planetary Data System (PDS) delivery of ChemCam data

Grants and Funding

2023	Co-I: Planetary Society STEP Grant for "Multiscale Characterization of Brine-Rich Planetary Analog Environments" ($49,284)
2023	Achievement Rewards for College Scientists (ARCS) Lim Award ($15,000)
2023	Center for Promoting Inclusion and Equity in the Sciences Summer Research Experience Award ($1500)
2022	National Science Foundation Graduate Research Fellowship Program (NSF GRFP)
2022	Georgia Tech Astrobiology Fellowship ($4000)
2022	Astrobiology Early Career Collaboration Award ($4530)
2019	NASA Connecticut Space Grant for Student Research ($5000)

Fellowships, Honors, & Awards

2023	ARCS Foundation Atlanta Scholar
2023	Georgia Institute of Technology Graduate Certificate in Astrobiology
2023	Earth and Environmental Science Graduate Service Award
2023	Graduates of Earth and Atmospheric Science (GEAS) Symposium 2nd Place Best Talk
2022 – 2025	NSF GRFP Fellow
2022 – 2023	Georgia Tech Astrobiology Fellowship
2020	High Honors Senior Thesis: "Experimental Evaporation and Spectral Analysis of Martian Analogue Brines."
2020	Wesleyan University Peirce Price for Excellence in Chemistry, Biology, or Geology
2019	Wesleyan Earth and Environmental Science Department Mckenna Fellow
2020	Spring Dean's List

2019 Fall and Spring Dean's List
2017 Spring Dean's List

Peer-Reviewed Publications

1) Evans, S. D., Hughes, I. V., **Hughes, E. B.**, Dzaugis, P. W., Dzaugis, M. P., Gehling, J. G., ... & Droser, M. L. (2024). A new motile animal with implications for the evolution of axial polarity from the Ediacaran of South Australia. Evolution & Development, e12491.
2) **Hughes, E. B.**, Wray, J., Karunatillake, S., Fanson, G., Harrington, E., & Hood, D. R. (2024). Water-Limited Hydrothermalism and Volcanic Resurfacing of Eridania Basin, Mars. Journal of Geophysical Research: Planets, 129(7), e2024JE008461. https://doi.org/10.1029/2024JE008461
3) Surprenant, R. L., Gehling, J. G., **Hughes, E. B.**, & Droser, M. L. (2023). Biostratinomy of the enigmatic tubular organism Aulozoon soliorum, the Rawnsley Quartzite, South Australia. Gondwana Research.
4) **Hughes, E.B.,** Gilmore, M., Martin, P.E. and Eleazer, M. (2023). Visible to near-infrared reflectance and Raman spectra of evaporites from sulfate-chloride Mars analogue brines. *Icarus*, p.115597 https://doi.org/10.1016/j.icarus.2023.115597
5) Droser, M. L., Evans, S. D., Tarhan, L. G., Surprenant, R. L., Hughes, I. V., **Hughes, E. B.**, & Gehling, J. G. (2022). What Happens Between Depositional Events, Stays Between Depositional Events: The Significance of Organic Mat Surfaces in the Capture of Ediacara Communities and the Sedimentary Rocks That Preserve Them. *Frontiers in Earth Science*, *10*(February), 1–17. https://doi.org/10.3389/feart.2022.826353
6) Droser, M., Evans, S., Dzaugis, P., **Hughes, E. B.**, Gehling, J., 2020, *Attenborites janeae*, A new enigmatic organism from the Ediacara Member (Rawnsley Quartzite), South Australia."*Australian Journal of Earth Sciences, 67*, 915-921.
7) Droser, M.L., Gehling, J.G., Tarhan, L.G., Evans, S.D., Hall, C.M., Hughes, I.V., **Hughes, E.B.**, Dzaugis, M.E., Dzaugis, M.P., Dzaugis, P.W. and Rice, D., 2019. Piecing together the puzzle of the Ediacara Biota: excavation and reconstruction at the Ediacara National Heritage site Nilpena (South Australia). *Palaeogeography, Palaeoclimatology, Palaeoecology*, *513*, pp.132-145.

White Papers

2021 Skok, J. R., Karunatillake, S., Zacny, K., **Hughes, E. B.**, Blank, J., Gaskin, J., Williams, A., Cannon, K., Edmunson, J., Parente, M. (2021). "SPRING Mission: Exploring the past and enabling the future of Mars. Planetary Science and Astrobiology Decadal Survey 2023-2032." white paper e-id. 360; Bulletin of the American Astronomical Society, Vol. 53, Issue 4, e-id. 360

2021 Karunatillake, S., Bramson, A.; Zacny, K., Dundas, C., Ojha, L., Aharonson, O., Vos, E., Hood, D. R., Rogers, D., Levy, J., Doran, P., Mandt, K., Wilson, J., **Hughes, E. B.** […] (2021). "GANGOTRI mission concept on the glacial key to the Amazonian climate of Mars." Planetary Science and Astrobiology Decadal Survey 2023-2032 white paper e-id. 357; Bulletin of the American Astronomical Society, Vol. 53, Issue 4, e-id. 357

Conference Abstracts and Presentations (Primary Author)

2024 **Hughes, E. B.**, Buffo, J., Wray, J., & Rivera-Hernandez, F. (2024, May). "Spectral Diversity of Sulfate Minerals in Canadian Lakes as Analogues for Early Mars." In 2024 Astrobiology Science Conference. AGU.

2024 **Hughes, E. B.**, F. Rivera-Hernández, W. Rapin, J. R. Johnson, P. Gasda, D. Das, E. Sklute, O. Gasnault, N. Lanza, L. C. Kah, B. Tutolo, P.Y. Meslin, E. Dehouck, R. Y. Sheppard. "Hydrated Na-Mg-Sulfate Suggests Warmer Concentrated Fluids Infultrated the Sulfate Unite, Gale Crater, Mars" (2024). Talk presented at 55th Lunar and Planetary Science Conference.

2024 **Hughes, E. B.**, J. J. Wray, F. Rivera-Hernández, P. Dharmapriya, S. Karunatillake, G. Kodikara, A. Sarbadhikari, V. M. Nair, Y. Srivastava, A. Rani, and the 2023 Expedition Team. "Raman and VNIR Spectra of Sri Lanka Serpentine Zone Minerals With Relevance to Nili Fossae and Jezero Crater, Mars" (2024). Poster presented at 55th Lunar and Planetary Science Conference.

2023 **Hughes, E. B.**, J. J. Buffo, F. Rivera Hernández, K. L. Lynch, J. J. Wray. "Season Changes in VNIR Spectra of Salts from Canadian Hypersaline Lakes with Relevance to Mars" (2023). Talk presented at Ancient and Future Brines conference.

2022 **Hughes, E. B.**, J. Wray, S. Karunatillake. "Amorphous Silica Deposits Suggest Aeolian and Glacial Conditions in Eridania Basin, Mars" (2022). Poster presented at 53rd Lunar and Planetary Science Conference.

2021 **Hughes, E.B.**, M.S. Gilmore, M. Eleazer "VNIR and Raman Spectral Characterization of Martian Analogue Chloride and Sulfate Brines" (2021). Talk given for the 52nd Lunar and Planetary Science Conference.

2021 **Hughes, E.B.**, Karunatillake, S., Hood, D. R. "Global and Regional Martian Regolith Compositions Derived from GRS and TES Data" (2021). Poster presented for 52nd Lunar and Planetary Science Conference.

2020 **Hughes, E. B.**, Karunatillake, Suniti, Hood, Donald. "Global Magnesium Mapping for Mars: Insights from Methodology Driven Variability" (2020). Poster presented at the 2020 Geologic Society of America (GSA) Conference.

2020 **Hughes, E. B.,** Gilmore, Martha S., Martin, Peter E. "Experimental Evaporation and Spectral Analysis of Martian Analogue Brines" (2020). Poster presented at 2020 American Geophysical Union (AGU) Conference.

2020 **Hughes, E. B.**, Gilmore, Martha S. "Characterization of Martian Salts through Experimental Evaporation and Spectral Analysis of Analogue Brines" (2020). Abstract accepted to the 2020 Lunar and Planetary Science Conference (LPSC).

2019 **Hughes, E. B.**, Zimbelman, James R. "Preliminary Observations of Transverse Aeolian Ridges in Digital Terrain Models" (2019). Poster presented at 2019 Lunar and Planetary Science Conference (LPSC).

Conference Abstracts and Presentations (Contributing Author)

2024 Nellessen, M.A., Newsom, H.E., Baker, A.M., Ganter, G., Jackson, R.S., Williams, J., Scuderi, L., Nachon, M., Hernandez, F.R., **Hughes, E.** and Gasda, P.J., 2024, July. "Utilization of ChemCam Shot-to-Shot Data to Identify and Distinguish Ca-Sulfate Cemented Bedrock from mixed Vein-Bedrock Features." In *International Conference on Mars* (Vol. 3007, p. 3469).

2024 Gasnault, O., Schroeder, S., Cousin, A., Frydenvang, J., **Hughes, E.**, Dehouck, E., Rammelkamp, K., Johnson, J., Rapin, W., Lanza, N. and Wiens, R.C., 2024. "Exploring the sulfate-bearing unit: Recent ChemCam results at Gale crater, Mars" (No. EPSC2024-1095). Copernicus Meetings.

2024 Gasda, P.J., Comellas, J., Essunfeld, A., **Hughes, E.**, Rapin, W., Sklute, E., Frydenvang, J., Dehouck, E., Forni, O., Goetz, W. and Crossey, L., 2024. "Diagenetic Features Observed by ChemCam from Glen Torridon to Mirador and Beyond." In *International Conference on Mars* (*3007*, p.3294).

2024 Forni, O., **Hughes, E.B.**, Rammelkamp, K., Rivera-Hernández, F., Rapin, W., Johnson, J.R., Gasda, P., Gasnault, O. and Lanza, N., 2024. "Late high temperature events interpreted from fluorine detections in Gale crater sulfate unit." In *International Conference on Mars*.

2024 Nisson, D., Daswani, M.M., Perl, S.M., **Hughes, E.**, Dharmapriya, P. and Karunatillake, S., 2024, May. "Paleo-Fluid Conditions of Sri Lankan Serpentine Zones as an Analog for Noachian Habitability." In *2024 Astrobiology Science Conference*. AGU.

2024 Buffo, J., **Hughes, E.**, Barklage, M., Brown, E.K., Pontefract, A., Spitzer, E., Nichols, F., Osburn, M.R., Plattner, T., Hunsaker, A. and Jacobs, J.M., 2024, May. "Multiscale

Characterization of Brine-Rich Planetary Analog Environments." In *2024 Astrobiology Science Conference*. AGU.

2024 Droser, M., Evans, S., Hughes, I., **Hughes, E.**, Dzaugis, P., Dzaugis, M., McCandless, H., Surprenant, R., Boan, P. and Irving, J., 2024, May. "Astrobiology in the Field: Forging Connections Between Paleontology and the Local Community in the South Australian outback." In *2024 Astrobiology Science Conference*. AGU.

2024 Tullier, A., Karunatillake, S., Tan, X. and **Hughes, E.**, 2024. "Overlapping Crater and Fault Lithostratigraphy in Elysium Planitia Using HiRISE Imagery." *LPSC 2024, 3040*, p.2680.

2024 Nair, V.M., Basu Sarbadhikari, A., Srivastava, Y., Dharmapriya, P.L., Malaviarachchi, S.P.K., Karunatillake, S., Rani, A., **Hughes, E.B.**, Wray, J.J., Nisson, D. and Melwani Daswani, M., 2024. "A Potential Intraplate Serpentinization Site of Sri Lanka as a Mars Analogue." *LPSC 2024, 3040*, p.2005.

2024 Malaviarachchi, S.P.K., Dharmapriya, P., Chandrajith, R., Pitawala, H.M.T.G.A., Karunatillake, S., **Hughes, E.**, Vithanage, M., Edussuriya, T., Ambegoda, T., Anandakiththi, K. and Wray, J., 2024. "Overview of Sri Lanka's Rare Occurrence of Serpentinites Within Proterozoic High-Grade Metamorphic Basement Rocks as a Mars-Context Research Site." *LPSC 2024*, *3040*, p.2324.

2024 Newsom, H.E., Gasda, P.J., Lanza, N.L., Scuderi, L.A., Dimitracopoulos, F.D., Gallegos, Z.E., Los, S.A., Gasnault, O.E., Tutolo, B.M., Fairén, A.G., Kite, E.S., and **Hughes, E.B.**, 2024. "Gale Crater Block Fields—Role of Dissolution and Other Processes." *LPSC 2024*, *3040*, p.2156.

2024 Rammelkamp, K., Gasnault, O., Schröder, S., Lomashvili, A. and **Hughes, E.B.**, 2024. "Depth Trends in ChemCam LIBS Data in the Sulfate Bearing Unit." *LPSC 2024.*

2024 Rammelkamp, K., Gasnault, O., Schröder, S., Lomashvili, A., **Hughes, E.B.**, Clave, E. and Egerland, C.H., 2024. "Optimization of tensor component analysis for depth trend investigation of ChemCam LIBS shot-to-shot data from Gale crater, Mars." *Helmholtz AI Conference 2024.*

2024 Rammelkamp, K., Gasnault, O., Schröder, S., Dehouck, E., Forni, O., Le Deit, L., Cousin, A., Lasue, J., Lomashvili, A., **Hughes, E.B.** and Lanza, N., 2024. "Unsupervised data exploration of ChemCam LIBS data from Gale crater, Mars." *EPSC 2024.*

2023 Burnett, C.J.A., **Hughes, E.B.**, Do, W.H. and Carr, C.E., 2023. "Preparation Methods for In Situ Salt-and Regolith-Derived Martian Concrete." Talk presented at Ancient and Future Brines conference., *2689*, p.2028.

2023 Jayakody, D.R., Ambegoda, T.D., Karunatillake, S. and **Hughes, E.B.**, 2023. "Optimized Field Sampling of Mars-Analog Serpentine Zones via Machine Learning." *LPI Contributions*, *2806*, p.2242.

2023 Manogaran, R., Tubbs, J.S., Bates, A., **Hughes, E.B.**, Ruj, T. and Karunatillake, S., 2023. "Paleohydraulic Investigation of Martian Equatorial Inverted Channels in a Volatile-Enriched Geochemical Province." *LPI Contributions*, *2806*, p.2224.

2023 Wallentine, W.L., Lynch, K.L., Eggers, G.L., **Hughes, E.B.**, Wray, J.J. and Rivera-Hernández, F., 2023. "Investigation of Sodium Sulfate Spectra from the Great Salt Lake as a Model for Characterizing Aqueous Geochemistry and Climate History of Martian Paleolakes." *LPI Contributions*, *2806*, p.2143.

2023 Boan, P., **Hughes, E.B.** and Vasquez, A.A., 2023. "Broader Impact: the Spatial Distribution of Martian Impact Craters." In *Geological Society of America Abstracts* (Vol. 55, p. 393450

2022 Boan, P.C. and **Hughes, E.B.**, 2022, March. "Spatial Distributions of Martian Impact Craters Moderated by Geologic Unit and Age." In *53rd Lunar and Planetary Science Conference* (Vol. 2678, p. 2355).

2022 Tan, X., Karunatillake, S., Susko, D., **Hughes, E.**, Rani, A., Liu, X., Haviland, H., Moitra, P. and Sarbadhikari, A.B., 2022, December. "pMELTS modeling of Elysium regions as a function of oxygen fugacity." In *Fall Meeting 2022*. AGU.

2022	Bates, A., Karunatillake, S., Lorenzo, J.M., Konsoer, K.M. and **Hughes, E.B.**, 2022, March. "Water-Limited Provenance of the Vastitas Borealis Formation Within Isidis Basin, Mars." In *53rd Lunar and Planetary Science Conference* (Vol. 2678, p. 2452)
2022	Fanson, G., Wray, J., Rivera-Hernandez, F., **Hughes, E.B.** and M. Novak, A., 2022. "Further evidence for ancient explosive volcanism in Northern Arabia Terra, Mars." In *Geological Society of America Abstracts* (Vol. 54, p. 380207).
2021	Boan, P., Evans, S., Hughes, I.V., **Hughes, E.B.**, Dzaugis, P.W. and Droser, M., 2021. "Spatial Point Pattern Analysis of Obamus Coronatus from Nilpena Ediacara National Park, South Australia." In *Geological Society of America Abstracts* (Vol. 53, p. 368517).
2020	Irving, J., Droser, M. and **Hughes, E.**, 2020, December. "Bringing to life the Ediacara seas in the Australian Outback." In *AGU Fall Meeting Abstracts* (Vol. 2020, pp. SY048-11).

Invited Talks

2024	Los Alamos National Laboratory: "Hydrated Na-Mg-Sulfate Suggests Warmer Concentrated Fluids Infiltrated the Sulfate Unit, Gale Crater, Mars"
2023	University of Peradeniya: "Evidence Against Hydrothermalism in Eridania Basin, Mars."
2021	LSU Astrophysics Lunch Seminar: "The Global Regolith Mineralogy of Mars in Geologic and Geochemical Context."
2020	Wabash College: "Global Mineralogical Mapping for Mars."
2020	University of Dhaka: "Global Mineralogical Mapping for Mars."

Undergraduate Research & Internships

Summer 2020	**NASA SUPPR Intern**, Louisiana State University *Duties:* Using Gamma Ray Spectroscopy data to derive and map global martian MgO concentrations; synthesizing Thermal Emission Spectrometer data with Gamma Ray Spectroscopy data to interpret global martian minerology; running the Planetary Reading Marathon journal club
2019 – 2020	**Research Assistant**, Wesleyan University *Duties*: Working with Professor of Geology Martha Gilmore to develop and study Martian analogue brines; designing and implementing technical work on a Mars analogue chamber; comparing resulting experimental data to data received from the Mars Reconnaissance Orbiter (MRO)
Summer 2018	**Planetary Science Intern**, Smithsonian Air and Space Museum *Duties*: Analzing over 500 images of Martian surface, identifying dominant and unique morphologies of Transverse Aeolian Ridges (TARs); organizing major outreach program "Mars Day" for thousands of museum visitors to learn about Mars

Workshops, Summer Schools and Training Courses Attended

2024	Jet Propulsion Laboratory Planetary Science Summer School (PSSS) participant
2023 – 2024	NASA Mars Ideation Factory Participant

Teaching Assistant Positions

Spring 2022	EAS 2600: Earth Processes (Georgia Tech)
Fall 2021	EAS 1601: Habitable Planet (Georgia Tech)
Spring 2020	E&ES 115: Planetary Geology (Wesleyan University)
Spring 2019	MATH 132: Elementary Statistics (Wesleyan University)

Undergraduate Mentoring

Summer 2023	Sydney Peters – Cal State Fresno c/o 2024
Fall 2021 – Spring 2022	Grace Fanson – Georgia Tech c/o 2022 – now a PhD student at MIT

Volunteer and Outreach Experience

Spring 2024	**Letters to a Pre-Scientist:** Exchanging letters with a middle schooler from an underserved community about scientific exploration and education
March 2024	**Atlanta Science Festival:** Prepared material for students to learn about spectroscopy and remote sensing at Georgia Tech
March 2023	**Atlanta Science Festival:** Helped run a booth teaching K-12 students about Mars, astrobiology, and the scale of the universe
2021 – Present	**Wikipedia Editor:** Significantly expanded the Wikipedia page for Goldich Dissolution Series; Significantly expanded the "Habitability Requirements" section of the Terraforming Wikipedia page
2020	**Sunrise Movement Worcester:** Member of Political and Trainings Teams
Summer 2019	**IN-Reach Coordinator:** Mentored a local high school student in remote sensing for Mars in a program benefiting minority and low-income Connecticut high school students

Organizations

2024 – Present	Astrobiology Society of America

Software and Coding Skills (ranked 1 – 5; 1 = novice; 5 = expert)

ENVI[5], MatLab[4], Excel[5], ArcMap[4], ArcGIS Pro[4], QGIS[3], Rstudio[1], Command Line[2], JMARs[2]

Instrument Techniques (ranked 1 – 5; 1 = novice; 5 = expert)

Laser Induced Breakdown Spectroscopy (LIBS)[3], X-Ray Florescence Spectroscopy (XRF)[4], Visible to Near Infrared Spectroscopy (VNIR)[5], X-Ray Diffraction Spectroscopy (XRD)[3], Raman Spectroscopy[3], Scanning Electron Microscopy with Electron Dispersion Spectroscopy (SEM/EDS)[2]

Planetary Dataset Experience

Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) data – processing and analysis in ENVI; ChemCam Laser Induced Breakdown Spectra (LIBS) and Remote-Micro Images (RMIs) – processing and analysis of spectra and major/minor oxides; MastCam images – analysis; Gamma Ray Spectroscopy (GRS) data – processing and analysis; Thermal Emission Spectroscopy (TES) – analysis; High Resolution Imaging System for Mars (HiRISE) – analysis in ArcGIS Pro; Context Camera (CTX) imagery – processing and analysis in ArcGIS Pro; Mars Orbital Laser Altimeter (MOLA) data – processing and analysis in ArcGIS Pro

Field Experience

Sri Lanka Serpentine Zones

- LIBS, XRF, VNIR field data from Sri Lanka serpentine zones across 5 field sites
- Geologic mapping and sample analyses

Cariboo Plateau, British Columbia

- Using VNIR, Raman and XRF spectral analysis on salts in hypersaline lakes in the Cariboo Plateau
- Aided in collection and preparation of brine samples for ion analysis and cell counts

Flinders Ranges, South Australia

- High familiarity with Ediacaran period type fossils from Rawnsley Quartzite member of the Wilpena Group, South Australia

- Experience in excavation of fossil beds, fossil identification, categorization, measurement, preservation, taphonomic analysis, relationship with trace fossils, energy regimes and ripple wavelength relationship, cross-section analysis

Marble Mountains, San Bernardino County, California

- Familiarity with the Marble Mountains paleozoic sedimentary geology
- Studied preservation, energy regimes, structural relationships between units, trilobite identification

Tapeats Sandstone Formation, Arizona

- Identified trace fossils (burrows) in Tapeats Sandstone

Kona and Hilo, Hawaii

- Managed a project on microplastics distribution based on particle size and shoreline distance across Hawaiian beaches

Gilette Castle State Park, Connecticut

- Categorized geologic relationships, stratigraphy and structural geology, geologic mapping
- Categorized metamorphic grade and regime