John P. Ortiz

Postdoctoral Research Associate
National Security Earth Science Group (EES-17)
Earth & Environmental Science Division
Los Alamos National Laboratory

LANL Experts Profile
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Areas of Specialization

multiphase flow & transport • hydrogeology • fracture-matrix interactions • computational physics model development • reactive transport • planetary science

Education

2024 Johns Hopkins University (JHU)
Ph.D. Candidate in Environmental Health & Engineering GPA: 3.53/4.00
Dissertation: Subsurface Flow and Transport Processes with Applications to Methane Variations on Mars
Advisor: Dr. Harihar Rajaram

2017 New Mexico Institute of Mining and Technology (NMT)
M.Sc. in Hydrology GPA: 3.89/4.00
Thesis: The role of fault-zone architectural elements and basal altered zones on downward pore pressure propagation and induced seismicity in the crystalline basement
Advisor: Dr. Mark Person

2015 Dartmouth College
B.A. in Earth Sciences with Honors GPA: 3.47/4.00
Honors Thesis: Quantifying regional sediment flux from observations of nearshore morphology in the Columbia River Littoral Cell
Advisor: Dr. W. Brian Dade

Planetary Exploration Mission Experience

2023 NASA TLS-SAM Experiment Proposal, Co-author
Co-authored proposal with members of TLS-SAM (Tunable Laser Spectrometer within the Sample Analysis at Mars) team proposing strategic timing of atmospheric sample experiments for Mars Science Laboratory (MSL) *Curiosity* rover to perform in order to constrain sub-diurnal methane variations at Gale crater, Mars. MSL *Curiosity* successfully executed one of the proposed experiments 23 September, 2023, and a second on 10 December, 2023. Authors: Daniel Lo (Univ. of Michigan), Sushil Atreya (Univ. of Michigan), Scot Rafkin (Southwest Research Institute), Jorge Pla-García (Centro de Astrobiología y Instituto Nacional de Técnica Aeroespacial; CSIC-INTA), John Moores (York University), Daniel Viúdez-Moreiras (CSIC-INTA), John Ortiz.

Honors & Awards

2024 "Spot" Performance Award (January), Los Alamos National Laboratory
For outstanding performance and lasting contribution in support of the Laboratory's mission and values.
From the award: "John's work on understanding methane transport on Mars, funded through an LDRD CSES Student Fellowship, has produced very high quality results gaining high visibility for LANL. His recent *Journal of Geophysical Research: Planets* article was picked up by news servers around the world, including *Newsweek* in the US. Finally, John's results were used to guide sample collection on Mars from the *Curiosity* rover, building new ties between NASA and LANL."

2020 R&D 100 Award Winner (*Amanzi-ATS*), Contributor
Contributed to the Amanzi-ATS multiphase flow and transport simulator project by augmenting code verification and benchmark tests in addition to maintaining user guide documentation. The code won an R&D 100 Award in September 2020. rdworldonline.com

2018 Top 20 Most Downloaded Recent Papers, Wiley Publishing (*Geofluids*)
Amongst articles published between July 2016 and June 2018, the article "Exploring the potential linkages..." (see Publications & Presentations) was in the top 20 for number of downloads in the 12-months post online publication.

2018 "Spot" Performance Award (May), Los Alamos National Laboratory
Going above and beyond the call of duty under tight and/or emergency deadlines to finish a project deliverable in the form of a software package that rapidly predicts underground nuclear explosion (UNE) subsurface fractured-rock gas tracer transport arrival times and detection windows to the earth's surface. Software was delivered to AFTAC (Air Force Technical Applications Center).

Research Funding

The asterisk (*) indicates a grant for which I was not an official PI due to graduate student status, but on which I was the lead writer and researcher.

2021 *CSES Student Fellowship, Planetary Science
In-depth 3-year investigation of subsurface methane transport in fractured rock environments on Mars. Multiple gas-phase methane transport and release mechanisms were be considered in addition to more accurate prediction of atmospheric methane concentrations through subsurface-atmosphere coupling of FEHM subsurface flow & transport simulator and an atmospheric mixing model implemented in Python. PI: Phil Stauffer (LANL); Student Fellow: John Ortiz (JHU-LANL); Co-Is: Roger Wiens (LANL), Harihar Rajaram (JHU), Kevin Lewis (JHU), Anthony Toigo (JHU-APL). Total: $190k ($126k).

2021 New Mexico Small Business Assistance (NMSBA) Program
Provided client/small-business owner a detailed workflow for analyzing natural fluctuations in water levels in wells due to solid-earth body tides in order to determine aquifer properties. The workflow is covered in a ~150-page user guide that provides detailed instructions for

using several pre-existing, Open-source programs to perform the analysis. The workflow allows the client to quickly and cheaply calculate aquifer properties as an alternative to performing expensive well pump tests. PI: Phil Stauffer (LANL). Total: $17k ($15k).

2020 New Mexico Small Business Assistance (NMSBA) Program
Seed funding to pursue preliminary work in tidal analysis for a client who owns a small environmental consulting firm. By analyzing water levels in wells in response to earth tides, aquifer properties can be calculated without the need to perform expensive pump tests. Investigated tidal analysis background and methods during the first year of funding and delivered a 20-page report to the client on the feasibility of this method, highlighting a path toward a workflow that could eventually be used by the client. PI: Phil Stauffer (LANL). Total: $17k ($15k).

2020 *CSES Rapid Response Research & Development Grant, Planetary Science
Seed funding for preliminary work and proof-of-concept results of subsurface methane gas transport in fractured-rock environments on Mars influenced by periodic barometric pressure variations. PI: Dylan Harp (LANL); Student: John Ortiz (JHU-LANL); Co-Is: Roger Wiens (LANL), Harihar Rajaram (JHU), Kevin Lewis (JHU). Total: $30k ($24.7k).

Research Experience

2020 - pres. Doctoral Student, GRA (Graduate Research Assistant)
Energy and Natural Resources Security Group (EES-16), Los Alamos National Laboratory
Wrote two successfully-funded LDRD CSES Planetary Science grants (see Research Funding) to pursue work modeling subsurface methane transport in fractured rock at Gale crater, Mars at 70% FTE for three years. Key outcomes were two published first-authored journal articles and co-authorship of a NASA proposal with the TLS-SAM Team for multiple atmospheric sampling experiments to be performed by the MSL *Curiosity* rover, forging new ties between NASA and LANL (see Planetary Exploration Mission Experience and Research Funding). Additional outcomes include release of the Mars-specific branch of FEHM (FEHM-Mars; https://doi.org/10.5281/zenodo.10455952) that feature code modifications in Fortran to adapt to martian conditions (e.g., reduced gravity, equation-of-state modifications consistent with Mars atmospheric "air") and a reactive transport capability allowing users to specify time-varying distribution coefficients for tracer adsorption problems related to temperature changes.

Collaborated with experimentalists in EES-14 and EES-16 to develop reactive gas transport models to determine transport properties of noble gases in variably saturated zeolitic and non-zeolitic rocks based on novel data from bench-scale diffusion experiments. Augmented reactive transport capabilities of FEHM by developing a new dual-site, competitive kinetic adsorption model to interrogate counter-intuitive radionuclide gas transport experimental results in zeolitic rocks. This work will improve gas tracer signal interpretation related to historical UNE test data and inform field-scale transport models.

Carried out programmatic work for government sponsors related to detecting and verifying underground nuclear explosion (UNE) tests. Performed pressure and gas transport predictions to support Low Yield Nuclear Monitoring (LYNM) program. Was also the lead developer Numerical Reduced Order Multiphase Model (NROMM) software package for rapid prediction of gas seepage times, which was developed for AFTAC (Air Force Technical

Applications Center) as part of a Trailblazer project (see Honors & Awards). The NROMM tool is a Python wrapper for FEHM that allows the user to use a simple, readable input file to run flow & transport UNE simulations with reactive tracers while handling meshing, initialization calculations, radioactive decay, and post-processing. Led a training workshop for end users of NROMM to members of the 21st Surveillance Squadron of AFTAC (see Workshops Facilitated).

Led a NMSBA (New Mexico Small Business Assistance; https://www.nmsbaprogram.org/) project (2021-24) to help a small environmental consulting firm dramatically reduce costs associated with interpreting aquifer hydrogeologic properties from well data. Demonstrated the use of frequency domain analysis and solid-earth tidal loading to estimate hydrogeologic properties without the need for expensive pump tests.

2017 - 2019 **Post-Master's Student, GRA**

Computational Earth Science Group (EES-16), Los Alamos National Laboratory

Lead developer of the Numerical Reduced Order Multiphase Model (NROMM) software package for rapid prediction of gas seepage times. Software application was developed for use on multiple platforms (Windows/Linux/MacOS) and was delivered to AFTAC.

Developed numerical approaches for detecting and verifying underground nuclear explosion (UNE) tests. Projects included simulating radionuclide gas transport in fractured geologic media using finite-element method (FEM) and control volume finite-element (CVFEM) numerical models, simulating high-pressure methane injection into shale samples to inform laboratory investigations, and determining laboratory- and field-scale transport properties of rocks using models and tracer experiments.

Developed a workflow for coupling discrete fracture networks (DFNs) generated in dfnWorks with a 3-D continuum mesh as a means of improving computational efficiency of flow and transport simulations related to UNEs. Developed and performed a suite of flow and transport verification tests using FEHM. Such model frameworks are useful for representing scenarios where the 3-D rock matrix or spherical cavity must be explicitly represented and coupled to planar fracture features.

Contributed to development of the Amanzi-ATS high performance computing (HPC) flow & transport simulator to meet the Nuclear Quality Assurance-1 (NQA-1) regulatory standard by improving code verification and benchmark tests in addition to maintaining software user guide documentation. Collaborated on a multi-lab program supported by the DOE Office of Environmental Management (DOE EM) to provide scientifically defensible and standardized assessments of the uncertainties and risks associated with the environmental cleanup and closure of waste sites. This software won an R&D 100 Award in September 2020 (see Honors & Awards).

2016 - 2017 **Graduate Research Assistant**

Earth and Environmental Sciences Department, NMT

Created transient 3-D finite-difference (FDM) models in MODFLOW to analyze induced seismicity risk resulting from fluid-fault interactions associated with a suite of basal reservoir injection scenarios. Also developed transient 2-D cross-sectional FDM models in MATLAB to test fluid-fault interactions for crystalline basement fault zones exhibiting local, dynamically enhanced permeability caused by excess fluid pressures. Developed new approaches for representing fault zones with multiple architectural components and identified several key hydrogeologic parameters that control deep propagation of the fluid pressure

envelope and thus present increased risk of induced or triggered seismic events.

Collaborated on an NSF-funded (via NM EPSCoR) field project deploying subsurface geophysical field survey equipment (transverse electromagnetics [TEM], magnetotellurics [MT]) for interpretation of deep saline geothermal flow regimes in order to evaluate potential hydrothermal systems in southern New Mexico.

2013 REU Research Intern
College of Earth, Ocean, and Atmospheric Sciences, Oregon State University

Completed an NSF-funded Research Experience for Undergraduates (REU) internship on coastal processes. Collected nearshore single-beam bathymetry data using jet skis. Interpolated nearshore topographic and bathymetric data to extract key spatial and temporal morphology metrics using MATLAB. Determined rates of longshore-uniform sandbar migration cycles along the Oregon and Washington coasts representing a huge component of seasonal coastal sediment flux.

2013 Research Intern
United States Army Corps of Engineers Field Research Facility, Duck NC

Supported active coastal evolution and erosion research by collecting and processing LiDAR observations during and after storm surges using both beach-based and amphibious vehicles (LARC-V; Lighter Amphibious Resupply Cargo 5-ton).

Created a paleo-hurricane record of St. Croix by performing grain-size analysis on sediment cores combined with charcoal carbon dating.

Workshops & Shortcourses

Workshops Facilitated

2021 NROMM Demo and Training for AFTAC
Led a training workshop and software demonstration for members of the AFTAC 21st Surveillance Squadron on use of the NROMM software package (see Honors & Awards). The NROMM tool I developed is a Python wrapper for FEHM that allows the user to use a simple, readable input file to run flow & transport UNE simulations with reactive tracers while handling meshing, initialization calculations, radioactive decay, and post-processing.

Relevant Shortcourses

2023 LYNM Underground Nuclear Weapons Testing Orientation Program (UNWTOP)
Nevada National Security Site (NNSS), Las Vegas, NV
Attended 4-day multi-lab program at the NNSS for nuclear intelligence orientation regarding history, challenges, and scientific topics related to underground nuclear weapons testing.

Teaching Experience

2019 Grading Assistant
Environmental Health & Engineering Department, Johns Hopkins University

Graded weekly homework assignments for 20+ upper-level undergraduate engineering students in an Introduction to Fluid Mechanics course. Occasionally taught course lectures as needed.

2015 - 2016 **Graduate Teaching Assistant**
Earth and Environmental Sciences Department, NMT
Developed lesson plans and led class lectures and field trips for 20+ students in intermediate and upper level undergraduate Earth Sciences lab sections. Taught lab sections for courses in both Geomorphology and Stratigraphy & Paleontology with work load totaling 20 hrs/week.

Skills

Programming/command languages

Python – Advanced proficiency. Designed and executed sensitivity analyses and parameter optimization algorithms for calibration of transport parameters in FEHM and PFLOTRAN numerical simulations. Developed a workflow for generating stochastic discrete fracture networks (DFNs) embedded in rock matrix via upscaling of properties to given mesh dimensions, compatible with FEHM and PFLOTRAN mesh and material files. Developed an atmospheric mixing model governed by eddy diffusivity within the planetary boundary layer (PBL) using a backward Euler finite-difference method scheme and coupled it to gas tracer fluxes produced by FEHM simulations. Developed a standalone software application for real-time predictions of gas breakthrough for use on Windows, Linux, and MacOS platforms.

Fortran – Intermediate proficiency in using the Fortran language to augment current and legacy flow and transport codes (e.g., FEHM). Added reactive transport capability allowing for competitive kinetic adsorption between multiple tracer species to multiple types of adsorbent loading sites. Developer and maintainer of a Mars-specific branch of FEHM (FEHM-Mars; https://doi.org/10.5281/zenodo.10455952) that features code modifications to adapt to martian conditions (e.g., reduced gravity, equation-of-state modifications for Mars "air") and a capability allowing users to specify time-varying distribution coefficients for tracer adsorption problems related to temperature changes.

Matlab – Advanced proficiency in writing scripts for data processing and developing a variety of iterative/numerical models to solve hydrogeologic environmental problems.

R – Intermediate proficiency in building a variety of statistical and machine learning models to interpret and synthesize hydrologic, geochemical, climatic, and environmental data. Collaborated on statewide New Mexico water budget research project predicting reference evapotranspiration using different statistical models on a wide range remote sensing parameters.

LaTeX – Advanced proficiency in typesetting/document preparation of technical and scientific documentation.

Bash/shell – Advanced proficiency in managing independent code development environments and automating/batching tasks using command line prompts and shell scripts.

Software, codes

FEHM – Expert proficiency in creating multiphase fluid flow simulations with mass transport. Created test suites comparing gas tracer transport within a fracture with matrix diffusion to an analytical solution governed by a modified Richard's equation for unsaturated flow (with immobile liquid phase) in order to test when multiphase flow significantly affects gas tracer transport. github.com/lanl/FEHM. Maintainer of Mars-specific release (FEHM-Mars; https://doi.org/10.5281/zenodo.10455952).

PFLOTRAN – Intermediate proficiency in creating multiphase fluid flow simulations with mass transport. Created test suites in similar capacity to work done with FEHM. Also used in conjunction with FEHM to validate the capabilities of DFNs to simulate flow & transport in fractured media under transient conditions. www.pflotran.org

LaGriT – Intermediate proficiency in generating numerical finite-element meshes for a variety of geological applications, including porous flow and transport modeling and DFNs. Proficient at generating meshes using the 3 interfaces: command line, batch driven via control file, and PyLaGriT Python command/batch interface. Developed Python/LaGriT workflow for translating explosive rock damage models to continuum permeability-damage fields in geologic frameworks. Have also worked on capability development by using novel approaches to combine continuum 3D grids with 2D DFN planes into unified meshes for use in transient flow and transport models. lagrit.lanl.gov/index.shtml

dfnWorks – Intermediate proficiency in generating 3D DFNs for simulating flow and transport, including generating continuum representations of fractured porous media with octree refinement using an upscaled discrete fracture matrix model (UDFM) workflow. dfnworks.lanl.gov

Git – Advanced proficiency in source code management/version control in application development and collaborating with colleagues on coding and software projects. Have experience maintaining Git repositories as a lead developer as well as in a supporting collaborator role.

ParaView – Advanced proficiency in interactive scientific data visualization and exploration by generating static figures and animations/videos. www.paraview.org

GDB (GNU Debugger) – Intermediate proficiency with command line debugging tool for augmenting current and legacy flow and transport codes written in Fortran and C++.

Modflow – Advanced proficiency in developing 3D transient and steady-state FDM models to solve a variety of hydrogeologic problems, including fluid-fault interactions as related to induced seismicity in thesis work, and basin-scale backwards modeling of groundwater solute transport as related to the Kirtland Air Force Base spill in Albuquerque, NM.

OpenFOAM – Intermediate proficiency in developing computational fluid dynamics (CFD) simulations of single and multiphase flow and transport simulations in laminar and turbulent regimes.

SPOTL: Some Programs for Ocean-Tide Loading – Intermediate proficiency in computing load tides and strains produced on the solid earth by both ocean tides and solid-earth body tides. https://igppweb.ucsd.edu/~agnew/Spotl/spotlmain.html

Sphinx – Advanced proficiency in generating and maintaining professional documentation of software projects as HTML and LaTeX output from reStructuredText sources. Have

supported documentation needs of various collaborative code projects (e.g., Amanzi-ATS, NROMM, and SlugTide-octave).

Adobe Illustrator – Advanced proficiency in creating and editing publication-ready figures and illustrative schematic diagrams and animations for use in peer-reviewed journal articles and conference presentations.

Microsoft Excel – Ranked #7 in the world at the 2008 Microsoft Office Worldwide Competition in Hawaii of 56,000 initial entrants (www.betheworldchamp.com), Ireland National Champion (of 436 entrants).

Other

Advanced proficiency in written and conversational Spanish (nine years of academic study).

Publications & Presentations

h-index: 7 (as of 7 August, 2024)
Total Citations: 132
1st-author peer-reviewed journal articles: 3

Journal articles & Reports

Peer reviewed

2024 Neil, C. W., Swager, K. C., , Bourret, S. M., **Ortiz, J. P.**, Stauffer, P. S. Rethinking porosity-based diffusivity estimates for sorptive gas transport at variable temperatures. (2024). *Environmental Science & Technology* (under review).

2024 Lucero, D. D., Bourret, S. M., **Ortiz, J. P.**, Fritz, B. G., Bodmer, M. A., Heath, J., Kuhlman, K., Ezzadine, S., Person, M. A., Stauffer, P. S., The PE1 Team. Permeability scaling relationships from core- to field-scale measurements: A characterization of P-Tunnel, Nevada National Security Site. (2024). *Scientific Reports* (submitted).

2024 **Ortiz, J. P.**, Rajaram, H., Stauffer, P. S., Lewis, K. W, Wiens, R. C., Harp, D. R. Subdiurnal methane variations on Mars driven by barometric pumping and planetary boundary layer evolution. (2024). *Journal of Geophysical Research: Planets*. 129, e2023JE008043. doi:10.1029/2023JE008043.

2022 **Ortiz, J. P.**, Rajaram, H., Stauffer, P. S., Harp, D. R., Wiens, R. C., Lewis, K. W. Barometric pumping through fractured rock: a mechanism for venting deep methane to Mars' atmosphere. (2022). *Geophysical Research Letters*. doi:10.1029/2022GL098946. (Cited by: 4).
(Cover article: https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1002/grl.62460).

2022 Neil, C. W., Boukhalfa, H., Xu, H., Ware, S. D., **Ortiz, J. P.**, Avendaño, S. T., Harp, D. R., Broome, S., Hjelm, R. P., Roback, R., Brug, W. P., Stauffer, P. H. Gas diffusion through variably-water-saturated zeolitic tuff: implications for transport following a subsurface nuclear event. (2022). *Journal of Environmental Radioactivity*. doi:10.1016/j.jenvrad.2022.106905. (Cited by: 7).

2021 Avendaño, S. T., Harp, D. R., Kurwadkar, S., **Ortiz, J. P.**, Stauffer, P. H. Continental-scale geographic trends in barometric-pumping efficiency potential: a North American case

study. (2021). *Geophysical Research Letters*. doi:10.1029/2021GL093875. (Cited by: 3).

2020 Petrie, E. S., Bradbury, K. K., Cuccio, L., Smith, K., Evans, J. P., **Ortiz, J. P.**, Kerner, K., Person, M. A., Mozley, P. S. Geologic characterization of nonconformities using outcrop and whole-rock core analogues: hydrologic implications for injection-induced seismicity. (2020). *Solid Earth*, 11(5),1803-1821. doi:10.5194/se-11-1803-2020.

2020 Bourret, S. M., Kwicklis, E. M., Harp, D. R., **Ortiz, J. P.**, Stauffer, P. H. Beyond Barnwell: Applying lessons learned from the Barnwell site to other historic underground nuclear tests at Pahute Mesa to understand radioactive gas-seepage observations. (2020). *Journal of Environmental Radioactivity*, 222. doi:10.1016/j.jenvrad.2020.106297. (Cited by: 14).

2019 Harp, D. R., **Ortiz, J. P.**, Stauffer, P. H. Identification of dominant gas transport frequencies during barometric pumping of fractured rock. (2019). *Scientific Reports (Nature Publishing Group)*, 9(1), 9537. doi:10.1038/s41598-019-46023-z. (Cited by: 17).

2019 **Ortiz, J. P.**, Person, M. A., Mozley, P. S., Evans, J. P., Bilek, S. L. The role of fault-zone architectural elements on pore pressure propagation and induced seismicity. (2019). *Groundwater*, 57(3): 465-478. doi:10.1111/gwat.12818. (Cited by: 16).

2019 Stauffer, P. H., Rahn, T., **Ortiz, J. P.**, Salazar, L. J., Boukhalfa, H., Behar, H. R., Snyder, E. E. Evidence for High Rates of Gas Transport in the Deep Subsurface. (2019). *Geophysical Research Letters*. doi:10.1029/2019GL082394. (Cited by: 17).

2018 Harp, D. R., **Ortiz, J. P.**, Pandey, S., Karra, S., Anderson, D., Bradley, C., Viswanathan, H., & Stauffer, P. H. Immobile Pore-Water Storage Enhancement and Retardation of Gas Transport in Fractured Rock. (2018). *Transport in Porous Media*, 1-26. doi:10.1007/s11242-018-1072-8. (Cited by: 16).

2017 **Ortiz, J. P.** The Role of Fault-Zone Architectural Elements and Basal Altered Zones on Downward Pore Pressure Propagation and Induced Seismicity in the Crystalline Basement. (2017). [Master's Thesis] *New Mexico Institute of Mining and Technology*. (Cited by: 1).

2016 Zhang, Y., Edel, S. S., Pepin, J., Person, M., Broadhead, R., **Ortiz, J. P.**, Bilek, S. L., Mozley, P. S., & Evans, J. P. Exploring the potential linkages between oil-field brine reinjection, crystalline basement permeability, and triggered seismicity for the Dagger Draw Oil field, southeastern New Mexico, USA, using hydrologic modeling. (2016). *Geofluids*. doi:10.1111/gfl.12199 (Cited by: 15).

2014 **Ortiz, J. P.** Quantifying regional sediment flux from observations of nearshore morphology in the Columbia River Littoral Cell. (2014). [Undergraduate Thesis] *Dartmouth College Senior Honors Thesis Collection*.

2014 Cohn, N., Ruggiero, P., **Ortiz, J. P.**, & Walstra, D. J. Investigating the role of complex sandbar morphology on nearshore hydrodynamics. (2014). *Journal of Coastal Research*, 70(sp1), 53-58. doi:10.2112/SI65-010.1. (Cited by: 20).

Not peer reviewed

2018 Stauffer, P. H., Rahn, T. A., **Ortiz, J. P.**, Salazar, L. J., Boukhalfa, H., & Snyder, E. E. Summary of a Gas Transport Tracer Test in the Deep Cerros Del Rio Basalts, Mesita del Buey, Los Alamos NM. United States. (2018). doi:10.2172/1417180. (Cited by: 2).

Invited Talks

2023 "The Mars Underground: Characterizing subsurface methane seepage on the Red Planet", Los Alamos Geological Society monthly meeting. 18 April, 2023.

2023 "The Mars Underground: Characterizing subsurface methane seepage on the Red Planet", New Mexico Bureau of Geology Seminar Series, New Mexico Bureau of Geology and Mineralogical Resources. 7 April, 2023.

Conference & Meetings Talks

2024 "Preferential adsorption of xenon in variably-saturated zeolitic tuff", LYNM Quad-Laboratory All-Hands Meeting, Lawrence Livermore National Laboratory. 25 June, 2024.

2023 "Sub-diurnal methane variations on Mars driven by barometric pumping and planetary boundary layer evolution". *Session: P44C The New Mars Underground III Oral*. AGU 2023 Fall Meeting in San Francisco, CA. 14 December, 2023.

2023 "The Mars Underground: Characterizing methane seepage on the Red Planet", LANL Center for Space and Earth Science (CSES) Symposium. 23 August, 2023.

2023 "The Mars Underground: Characterizing methane seepage on the Red Planet", LDRD Appraisal for FY21-23, CSES Planetary Science Student Fellow. 17 April, 2023.

2023 "NROMM: Numerical Reduced-Order Multiphase Model | A tool for making rapid predictions of UNE gas seepage", LYNM Program Technical Meeting, Los Alamos National Laboratory. 23 January, 2023.

2022 "Using legacy radionuclide data to validate barometric pumping models", LYNM Quad-Laboratory All-Hands Meeting, Sandia National Laboratory. 25 May, 2022.

2022 "PE1-A pressure and permeability predictions", LYNM Quad-Laboratory All-Hands Meeting, Sandia National Laboratory. 26 May, 2022.

2021 "PE1-A pressure and gas arrival predictions based on in-situ permeability measurements", Nuclear Test Monitoring Exchange of Information by Visit and Report (EIVR) 58. 12 October, 2021.

2018 "A reduced-order model to assist real-time predictions of gas transport in unsaturated fractured media". InterPore 10th Annual Meeting in New Orleans, LA. May 2018.

2018 "Analysis of enhanced gas transport in fractured rock due to barometric pressure variations" (presenting for Dylan Harp). InterPore 10th Annual Meeting in New Orleans, LA. May 2018.

2017 "Improving estimates of subsurface gas transport in unsaturated fractured media using field tracer data and numerical methods." *Session: H52A Advances in Hydrological Characterization of Flow and Transport in Fractured Media: Numerical and Experimental Observations II*. AGU 2017 Fall Meeting in New Orleans, LA. 15 December 2017.

2016 "The Hydrologic Connection Between Basal Reservoir Injection, Crystalline Basement Fault Zones, and Induced Seismicity". GSA Annual Meeting in Denver, CO. September 2016.

Conference Posters

2024 From Manhattan to Mars: Applying Models of Subsurface Radionuclide Gas Seepage from Nuclear Testing to Understand Methane Release from the Martian Subsurface. *LANL Center for Space and Earth Science (CSES) Symposium*. 7 August, 2024.

2023 Sub-diurnal methane variations on Mars driven by barometric pumping and planetary boundary layer evolution. *LANL Student Symposium*.

2022 Barometric pumping through fractured rock: A mechanism for venting deep underground methane to Mars' atmosphere. *Session: P22F The New Mars Underground: Nexus of Decadal*

Planetary Science Objectives II Poster. AGU 2022 Fall Meeting in Chicago, IL.

2018 Coupled discrete fracture and 3D continuum domain representation to efficiently capture gas transport from underground cavities. *Session: H51P Coupled Processes in Fractured Media Across Scales: Experimental and Modeling Advances Posters*. AGU 2018 Fall Meeting in Washington D.C.

2018 Identifying dominant barometric frequencies driving gas transport in fractured rock (presenting for Dylan Harp). *Session: H51P Coupled Processes in Fractured Media Across Scales: Experimental and Modeling Advances Posters*. AGU 2018 Fall Meeting in Washington D.C.

2013 Interannual Sandbar Variability within the Columbia River Littoral Cell. *Session: EP13A Coastal Geomorphology and Morphodynamics I Posters*. AGU 2013 Fall Meeting in San Francisco, CA.

News Coverage/Web Articles

2024 "Mystery of Mars' 'Burps' Could Aid Search for Life". ***Newsweek***, 25 January 2024. https://www.newsweek.com/mystery-mars-burp-belch-methane-search-life-1863907.

2024 "Study Predicts Best Times for Rover to Sample Mars Methane in Search for Life". *Johns Hopkins University Engineering News*, 26 January 2024. https://engineering.jhu.edu/news/study-predicts-best-times-for-rover-to-sample-mars-methane-in-search-for-life/.

2024 "Atmospheric Pressure Changes Could Be Driving Mars' Elusive Methane Pulses". *Los Alamos Daily Post*, 26 January 2024. https://ladailypost.com/lanl-atmospheric-pressure-changes-could-be-driving-mars-elusive-methane-pulses/.

2024 "Methane pulses on Mars possibly driven by atmospheric pressure changes". *Phys.org*, 24 January 2024. https://phys.org/news/2024-01-methane-pulses-mars-possibly-driven.html.

2024 "Mars' methane release tied to atmospheric pressure fluctuations". *New Mexico Sun*, 25 January 2024. https://newmexicosun.com/stories/653884854-mars-methane-release-tied-to-atmospheric-pressure-fluctuations.

2024 "Mars' methane release tied to atmospheric pressure fluctuations". *Türkiye Newspaper*, 25 January 2024. https://www.turkiyenewspaper.com/science/17875.

2024 "火星でメタンを測るには日の出の直前が最適？メタン濃度の変化をモデル計算で予測 [Is the best time to measure methane on Mars just before sunrise? Predicting changes in methane concentration using model calculations]". *Sorae*, 12 February 2024. https://sorae.info/astronomy/20240212-mars-methane.html

2024 "Atmospheric pressure changes could be driving Mars' elusive methane pulses". *LANL News Stories*, 24 January 2024. https://discover.lanl.gov/news/0124-mars-methane-pulses/.

2024 "Atmospheric pressure changes could be driving Mars' elusive methane pulses". *LANL News Stories*, 24 January 2024. https://int.lanl.gov/news/news_stories/2024/january/0124-mars-methane-pulses.shtml?source=topnews (internal LANL webpage).

2024 "Atmospheric pressure changes could explain Mars methane".*Universe Today*, 29 January 2024. https://www.universetoday.com/165470/atmosphere-pressure-changes-could-explain-mars-methane/.

2024 "NASA's Curiosity Rover Closer to Solving Mystery of Methane Biosignature on Mars, Aiding Search for Life". *The Debrief*, 5 February 2024. https://thedebrief.org/nasas-curiosity-rover-closer-to-solving-mystery-of-methane-biosignature-on-mars-aiding-search-for-life/.

2022 "Study illuminates Mars methane transmission from subsurface depths that could indicate microbial source". *STE Highlights*, August 2022. https://www.lanl.gov/science-innovation/science-highlights/2022/2022-08.php#EarthandEnvironmentalSciences-1

2022 "Study illuminates Mars methane transmission from subsurface". *LANL News Stories*, 21

August 2022. https://int.lanl.gov/news/news_stories/2022/august/0822-mars-methane.shtml (internal LANL webpage).

2022 "Progress on understanding radioactive gas migration from underground nuclear explosions". *STE Highlights*, February 2022. https://www.lanl.gov/science-innovation/science-highlights/2022/2022-02.php#EarthandEnvironmentalSciences-1

Departmental Seminars and Other Talks

2023 "Predicting martian methane variations to identify strategic sampling times for the *Curiosity* rover", LANL, EES-16 SFT Lightning Talk. 1 November, 2023.

2022 "The Mars Underground: Characterizing subsurface methane seepage on the Red Planet", Johns Hopkins University, Baltimore, MD. Environmental Health & Engineering Seminar. 20 September 2022.

2021 "From Manhattan to Mars: Applying models of subsurface radionuclide gas seepage from nuclear testing to understand methane release from the martian subsurface", Johns Hopkins University, Baltimore, MD. Environmental Health & Engineering Seminar. 2 November 2021.

2021 "Determining hydrogeologic properties using well data, barometric pressures, and tidal analysis", LANL, EES-16 Science Café series. 12 August 2021.

2021 "From Manhattan to Mars: Generating novel insights into methane fluctuations on the Red Planet", Johns Hopkins University, Baltimore, MD. Environmental Health & Engineering Seminar. 2 March 2021.

2019 "Improving estimates of gas transport in fractured rock – Implications for verification of underground nuclear events", Johns Hopkins University, Baltimore, MD. Environmental Health & Engineering Seminar. 29 October 2019.

2020 "NROMM Seepage Tool: recent capability development and analytical verification", LANL, EES-16 Science Café series. 23 July 2020.

2019 "Noble gas diffusion through variably saturated rock – implications for verification of subsurface nuclear events", LANL, EES-16 Science Café series. 8 August 2019.

2018 "The role of fault-zone architectural elements and basement altered zones on pore pressure propagation and induced seismicity", LANL, EES-16 Science Café series. 2 August 2018.

2017 "Improving estimates of subsurface gas transport in unsaturated fractured media using field tracer data and numerical methods", LANL, EES-16 Science Café series. 30 November 2017.

Service Activities and Outreach

Session Chair

2024 *Session Convener, AGU Fall Meeting 2024*
"The New Mars Underground: Fluids, Volatiles, and the Future of Mars Exploration", Washington DC.

Journal Reviewer

Geophysical Research Letters
Icarus
Journal of Geophysical Research: Solid Earth
Hydrogeology Journal

Public Outreach

April 2024 *Los Alamos Middle School Guest Lecturer*
Delivered a series of five presentations over two days on measuring atmospheric methane on Mars with the *Curiosity* rover to several 7^{th} and 8^{th} grade classes of Life Sciences and Astronomy students at Los Alamos Middle School.

April 2023 *Los Alamos Geological Society monthly meeting*
Delivered an invited talk ("The Mars Underground: Characterizing subsurface methane seepage on the Red Planet"; see Invited Talks) about predicting methane abundance variations at Gale crater, Mars to members of the Los Alamos Geological Society for their monthly meeting.

Advisory Roles

2018 - 2019 *LANL Student Programs Advisory Committee (SPAC)*
Served as a 1-year appointment as Graduate Student Representative to a committee that advises Los Alamos National Laboratory's Student Programs Office on matters related to the hiring and general well-being of student employees.
https://int.lanl.gov/employees/education/spac.shtml

Professional Affiliations

2013 - pres. American Geophysical Union (AGU)
2015 - pres. American Association of Petroleum Geologists (AAPG)
2016 - pres. Geological Society of America (GSA)
2017 - pres. National Ground Water Association (NGWA)
2017 - pres. New Mexico Geological Society (NMGS)
2018 - pres. International Society for Porous Media (InterPore)