John P. Ortiz

Ph.D. Candidate
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Areas of Specialization

numerical modeling • hydrogeology • fractures • planetary science • petroleum geofluids

Education

Current — Johns Hopkins University (JHU)
Ph.D. Student in Environmental Health & Engineering

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

2014 — Dartmouth College
B.A. in Earth Sciences with Honors
Honors Thesis: Quantifying regional sediment flux from observations of nearshore morphology in the Columbia River Littoral Cell

Honors & Awards

2020 — R&D 100 Award Winner (*Amanzi-ATS*), Contributor
Contributed to the Amanzi-ATS 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 fractured rock gas transport to the earth's surface.

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 methane transport and release mechanisms will be considered in addition to more accurate atmospheric forcing provided through subsurface-atmosphere

coupling of FEHM subsurface simulator and MarsWRF general circulation model. PI: Phil Stauffer (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 the client/small-business owner detailed workflow for analyzing natural fluctuations in water levels in wells 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 will allow 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 transport in fractured rock environments on Mars influenced by periodic barometric pressure variations. PI: Dylan Harp (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

Carrying out programmatic work for government sponsors related to detecting and verifying underground nuclear explosion (UNE) tests in addition to performing research tasks for Ph.D. Some continuation of research and responsibilities from Post-Master's Student appointment.

Lead a NMSBA (New Mexico Small Business Assistance; https://www.nmsbaprogram.org/) project (2020-22) to help a small environmental consulting firm 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.

Previously Computational Earth Science.

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 is developed for use on multiple platforms (Windows/Linux/MacOS).

Developed numerical approaches for detecting and verifying underground nuclear explosion (UNE) tests. Projects includes 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 sam-

ples to inform laboratory investigations, and determining laboratory- and field-scale transport properties of rocks using models and tracer experiments.

Developed 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 3D finite-difference (FDM) models in MODFLOW to analyze fluid-fault interactions as pertaining to a suite of basal reservoir injection scenarios. I also developed transient 2D 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. In my work, I 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 seismic events.

Collaborated on an NSF-funded (via NM EPSCoR) field project deploying subsurface 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 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 by collecting and interpolating nearshore topographic and bathymetric data to extract key spatial and temporal 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

Studied coastal evolution and erosion by collecting and processing LiDAR observations during and after storm surges.

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

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 Geomorphology and Stratigraphy & Paleontology with work load totaling 20 hrs/week.

Skills

Programming/command languages

Python – High proficiency in designing and executing sensitivity analyses of FEHM and PFLOTRAN numerical models and generating nodal grids for finite-element meshes. Have also developed a standalone software application for real-time predictions of gas breakthrough for use on Windows, Linux, and MacOS platforms.

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

Fortran – Moderate proficiency in augmenting current and legacy flow and transport codes (e.g., FEHM). Maintainer of a custom, Mars-specific branch of FEHM (FEHM-Mars) that features code modifications to adapt to martian conditions (e.g., reduced gravity) and a capability allowing users to specify time-varying distribution coefficients for tracer adsorption problems.

R – Moderate proficiency in building a variety of statistical models to interpret and synthesize climatic, hydrologic, geochemical, 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– High proficiency in typesetting/document preparation of technical and scientific documentation.

Bash/shell

Software, codes

Fehm – High proficiency in creating multi-phase fluid flow simulations with mass transport. Created test suites comparing vapor 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 multi-phase flow significantly affects gas tracer transport. github.com/lanl/FEHM

Pflotran – Intermediate proficiency in creating multi-phase fluid flow simulations with mass transport. Created test suites in similar capacity to work done with FEHM. Also used in conjunction with FEHM to verify the capabilities of discrete fracture networks (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 discrete fracture networks. Proficient at generating meshes using the 3 interfaces: command line, batch driven via control file, and PyLaGrit Python command/batch interface. Have also worked on capability development by using novel approaches to combine continuum 3D grids with 2D discrete fracture network (DFN) planes into unified meshes for use in transient flow and transport models. lagrit.lanl.gov/index.shtml

dfnWorks – Moderate proficiency in generating 3D discrete fracture networks (DFN) 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

Modflow – High 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.

SPOTL: Some Programs for Ocean-Tide Loading – Moderate proficiency at 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 – High proficiency in generating and maintaining professional documentation of software projects as HTML and LaTeX output from reStructuredText sources.

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

ParaView – Moderate proficiency in interactive scientific visualization and exploration by representing data in static figures and videos. www.paraview.org

GDB (GNU Debugger) – Moderate proficiency with command line debugging tool for current and legacy flow and transport codes.

Petromod – Moderate proficiency in creating basin evolution, subsidence rate, and heat flow models of several American petroleum-bearing locales.

ArcGIS – Moderate proficiency in using digital elevation models (DEM) to delineate watersheds and create estimates of stream discharge in mountainous terrain.

Adobe Illustrator – High proficiency in creating and editing publication-ready figures and illustrative schematic diagrams.

COMSOL Multiphysics – Beginner proficiency in modeling contaminant transport in academic coursework.

Microsoft Excel – Ranked #7 in the world at Microsoft Office Worldwide Competition 2008 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

Journal articles & Reports

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. *Geophysical Research Letters*. doi:10.1029/2022GL098946.
(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. *Journal of Environmental Radioactivity*. doi:10.1016/j.jenvrad.2022.106905.

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. *Geophysical Research Letters*. doi:10.1029/2021GL093875.

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. *Solid Earth*, 11(5),1803-1821. doi:10.5194/se-2020-20.

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. *Journal of Environmental Radioactivity*, 222. doi:10.1016/j.jenvrad.2020.106297.

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

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. *Groundwater*, 57(3): 465-478. doi:10.1111/gwat.12818

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. *Geophysical Research Letters*. doi:10.1029/2019GL082394.

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. *Transport in Porous Media*, 1-26. doi:10.1007/s11242-018-1072-8

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. doi:10.2172/1417180.

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. *New Mexico Institute of Mining and Technology.*

2016 Zhang, Y., Edel, S. S., Pepin, J., Person, M., Broadhead, R., **Ortiz, J. P.**, Bilek, S. L., Mozley, P. S., & Evans, J. P. (2016). 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. *Geofluids*. doi:10.1111/gfl.12199

2014 **Ortiz, J. P.** Quantifying regional sediment flux from observations of nearshore morphology in the Columbia River Littoral Cell. *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. *Journal of Coastal Research*, 70(sp1), 53-58. doi:10.2112/SI65-010.1

Invited Talks

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.

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

Conference Talks & Posters

2022 **Ortiz, J. P.**, Rajaram, H., Stauffer, P. H., Harp, D. R., Wiens, R. C., Lewis, K. W. Barometric pumping through fractured rock: A mechanism for venting deep underground methane to Mars' atmosphere, poster presentation. *Session: P22F The New Mars Underground: Nexus of Decadal Planetary Science Objectives II Poster*. AGU 2022 Fall Meeting in Chicago, IL.

2018 **Ortiz, J. P.**, Harp, D. R., Stauffer, P. H., Gable, C. W., Makedonska, N. Coupled discrete fracture and 3D continuum domain representation to efficiently capture gas transport from underground cavities, poster presentation. *Session: H51P Coupled Processes in Fractured Media Across Scales: Experimental and Modeling Advances Posters*. AGU 2018 Fall Meeting in Washington D.C.

2018 Harp, D. R., **Ortiz, J. P.**, Kwicklis, E. M., Bourret, S. M., Viswanathan, H., Stauffer, P. H. Identifying dominant barometric frequencies driving gas transport in fractured rock, poster presentation (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.

2018 **Ortiz, J. P.**, Harp, D. R., Stauffer, P. H. A reduced-order model to assist real-time predictions of gas transport in unsaturated fractured media, oral presentation. InterPore 10th Annual Meeting in New Orleans, LA (May 2018).

2018 Harp, D. R., **Ortiz, J. P.**, Stauffer, P. H., Viswanathan, H., Anderson, D. N., Bradley, C. Analysis of enhanced gas transport in fractured rock due to barometric pressure variations, oral presentation (presenting for Dylan Harp). InterPore 10th Annual Meeting in New Orleans, LA (May 2018).

2017 **Ortiz, J. P.**, Ortega, A. D., Harp, D. R., Boukhalfa, H. Improving estimates of subsurface gas transport in unsaturated fractured media using field tracer data and numerical methods, oral presentation. *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.

2016 **Ortiz, J. P.**, Person, M. A., Mozley, P. S., Evans, J. P. The Hydrologic Connection Between Basal Reservoir Injection, Crystalline Basement Fault Zones, and Induced Seismicity, oral presentation. September 2016 GSA Annual Meeting in Denver, CO.

2013 **Ortiz, J. P.**, Ruggiero, P., Cohn, N. Interannual Sandbar Variability within the Columbia River Littoral Cell, poster presentation. *Session: EP13A Coastal Geomorphology and Morphodynamics I Posters*. AGU 2013 Fall Meeting in San Francisco, CA.

Departmental Seminars

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.

News/Web Articles

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

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)

Service to Profession

Journal Reviewer

Geophysical Research Letters *Hydrogeology Journal*

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.