Juan David Hernández-Montenegro

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EDUCATION AND ACADEMIC APPOINTMENTS

2026	**Postdoctoral Associate – Center for Planetary Origins to Habitability (CPO2H), Rice Space Institute, Rice University.**
2020 - 2025	**Ph.D. Geology – California Institute of Technology, GPS Division** Advisors: Paul Asimow & Claire Bucholz.
2023	**M.Sc. in Geology – California Institute of Technology, GPS Division**
2019	**M.Sc. in Geology – Universidad Nacional de Colombia** Thesis: “Generation and evolution of TTG magmas in the Archean: Implications for the formation of the continental crust.”
2016	**B.Sc. in Geology – Universidad Nacional de Colombia** Thesis: “Geochemistry, Petrology and Isocon analysis of migmatitic rocks in the Wet Mountains, Colorado.”
2015	**B.Eng. (Hons) Geodesy – Universidad Distrital Francisco José de Caldas** Thesis: “Landslide susceptibility mapping and assessment in the Sumapaz Basin using Fuzzy Set Theory and GIS.”
2006	**High School Technical Diploma – Instituto Técnico Industrial Centro Don Bosco**

SCHOLARSHIPS AND AWARDS

2024 - 2025	Garen Graduate Fellowship. Caltech Center for Comparative Planetary Evolution
2025	Stanford Postdoctoral Recruitment Initiative in Sciences and Medicine (PRISM) (Postdoctoral offer declined)
2024	Magma Supply and Imaging Workshop Grant. Magmatic Drivers of Eruption Working Group, SZ4D
2022	3CPE Program - Caltech Microanalysis Center Grant.
2021	Foster and Coco Stanback Travel and Conference Grant.
2020 - 2024	Fulbright Scholarship. Colombia
2020	Laureate Thesis (Master's thesis with highest academic honor)
2017	Talent Recruitment Program. Colfuturo. Colombia
2017 - 2019	"Honor Degree" Scholarship for graduate studies. Faculty of Science. Universidad Nacional de Colombia
2016	Valedictorian. Faculty of Science. Universidad Nacional de Colombia
2015	Undergraduate Research Experience Purdue-Colombia Fellowship (UREP-C). Purdue University.
2014	Introduction to Research Grant. “Geochemical and Petrological characterization of very low-grade metamorphic rocks”. Division of Research. Universidad Nacional de Colombia
2014	Efi-Ciencias Prize. Faculty of Science. Universidad Nacional de Colombia
2011 - 2016	Dean’s List. Faculty of Science. Universidad Nacional de Colombia

PUBLICATIONS

Manuscripts in preparation

Hernández-Montenegro, J. D., Asimow, P. D., Cheng K.W., & Tackley, P. J. Implications of a basal magma ocean above the core-mantle boundary for the thermal evolution of Mars.

Hernández-Montenegro, J. D., Maldonado, E., Dong, J., & Sáez, A., & Asimow, P. D., Intrusive Magmatism as a source of mid-crustal water on Mars.

Hernández-Montenegro, J. D., Bucholz, C. E., Ibarra, D. E., Sosa, E. S., & Rodríguez-Vargas, A. Systematic variations in the triple oxygen isotope composition and redox state of the lower crust.

Hernández-Montenegro, J. D., Bucholz, C. E., Ibarra, D. E., Spencer, C.J., Villaseca, C., Castellanos-Alarcón, O. M., Dahlquist, J.A., Alasino, P.H., & Sánchez, P. Temporal variations in the triple oxygen isotope composition of granites reveal changes in the weathering patterns across Earth's geological history

Published and submitted papers

Bucholz, C. E., Wilner, O., **Hernández-Montenegro, J. D.**, & Sánchez, P. Global lithium enrichment in granites since the Paleozoic linked to enhanced clay production. Nature Geoscience. (*In review*).

Hernández-Montenegro, J. D., Kizovski T. V., Treiman A. H., Li A.Y., Asimow, P. D., Schmidt M. E., Liu Y., et al. (2025). Petrogenesis of the olivine cumulate outcrop Issole – the missing link between the Séítah and Máaz formations in Jezero crater, Mars. *Icarus*.

Treiman A. H., **Hernández-Montenegro, J. D.**, Wiens R. C., Wade L., VanBommel S. J., et al. (2025). The Brac/Dourbes olivine-cumulate rock, Séítah Formation, Jezero Crater floor, Mars: Its parent magma, and relation to basalts of the Máaz Formation. *Journal of Geophysical Research: Planets*.

Schmidt M. E., Kizovski T. V., Liu Y., **Hernández-Montenegro, J. D.**, Tice M. M., Treiman A. H., Hurowitz J. A., et al. (2025). Diverse and highly differentiated lava suite in Jezero crater, Mars: Constraints on intracrustal magmatism revealed by Mars 2020 PIXL. *Science Advances*.

Bucholz, C. E. & **Hernández-Montenegro, J. D.** (2025). Temporal variation in oxygen isotopes of peraluminous granites derived from sedimentary sources. *Lithos*, *492*, 107864.

Hernández-Montenegro, J. D., Asimow, P. D., & Herzberg, C. T. (2024). Estimating primary magmas from Mars with PRIMARSMELT: Implications for the petrogenesis of some Martian rocks and the thermal evolution of Mars. *Journal of Geophysical Research: Planets*, *129*(11), e2024JE008508.

Hernández-Montenegro, J. D., Bucholz, C. E., Sosa, E. S., Kipp, M. A., & Tissot, F. L. (2024). Iron isotope fractionation during partial melting of metapelites and the generation of strongly peraluminous granites. *Geochimica et Cosmochimica Acta*, *380*, 112-130.

Sosa, E. S., Bucholz, C. E., **Hernández-Montenegro, J. D.**, Rodríguez-Vargas, A., Kipp, M. A., & Tissot, F. L. (2024). Garnet clinopyroxenite formation via amphibole-dehydration in continental arcs: Evidence from Fe isotopes. *Earth and Planetary Science Letters*, *648*, 119050.

Roberts, N. M., **Hernández-Montenegro, J. D.**, & Palin, R. M. (2024). Garnet stability during crustal melting: Implications for chemical mohometry and secular change in arc magmatism and continent formation. *Chemical Geology*, 659, 122142.

Sosa, E. S., Bucholz, C. E., **Hernández-Montenegro, J. D.**, Kipp, M. A., Tissot, F. L. H., Ratschbacher, B. C., Jackson, J. M., Kay, S. M., & Kay, R. W. (2024). Lower crustal control in the iron isotope systematics of plutonic xenoliths from Adak Island, Central Aleutians, with implications for arc magma geochemistry. Geochimica et Cosmochimica Acta, 377, 1–18.

Hernández-Uribe, D., Holder, R. M., & **Hernández-Montenegro, J. D.** (2024). Eclogite thermobarometry: The consistency between conventional thermobarometry and forward phase-equilibrium modelling. *Journal of Metamorphic Geology*, *42*(1), 89-108.

Herzberg, C. T., Asimow, P. D., & **Hernández-Montenegro, J. D.** (2023). The Meaning of Pressure for Primary Magmas: New Insights From PRIMELT3-P. *Geochemistry, Geophysics, Geosystems*, *24*(1), e2022GC010657.

Triantafyllou, A., Ducea, M. N., Jepson, G., **Hernández-Montenegro, J. D.**, Bisch, A., & Ganne, J. (2023). Europium anomalies in detrital zircons record major transitions in Earth geodynamics at 2.5 Ga and 0.9 Ga. *Geology*, *51*(2), 141-145.

Palin, R. M., Palmer, Z., Holm-Denoma, C., Hernández-Uribe, D., & **Hernández-Montenegro, J. D.** (2023). On the occurrence of amphibolite-facies sapphirine, spinel, phlogopite, anorthite, and corundum in the Wet Mountains, Colorado, USA. *Lithos*, *440*, 107024.

Hernández-Montenegro, J. D., Palin, R. M., Zuluaga, C. A., & Hernández-Uribe, D. (2021). Archean continental crust formed by magma hybridization and voluminous partial melting. *Scientific Reports*, *11*(1), 5263.

Hernández-Uribe, D., **Hernández-Montenegro, J. D.**, Cone, K. A., & Palin, R. M. (2020). Oceanic slab-top melting during subduction: Implications for trace-element recycling and adakite petrogenesis. *Geology*, *48*(3), 216-220.

Hernández-Montenegro, J. D., Andronicos, C. L., Zuluaga, C. A., & Aronoff, R. F. (2019). Effects of melt loss, melt retention, and protolith composition on differentiation of anatectic metapelites: A case study of the Wet Mountains, Colorado. *Lithos*, *344*, 425-439.

RESEARCH AND PROFESSIONAL EXPERIENCE

2021 - 2025 **Jet Propulsion Laboratory (JPL/NASA)**
Student Collaborator, PIXL team, Mars 2020 mission
- Processing and analysis of geochemical data from the Planetary Instrument for X-Ray Lithochemistry (PIXL) onboard the Perseverance rover on Jezero Crater, Mars.
- Planning and execution of science operation activities for the PIXL instrument.
- Modeling and characterization of mafic and ultramafic rocks on Jezero Crater, Mars.

2020 - Present **California Institute of Technology, CA, USA**
Graduate Student, Division of Geological and Planetary Sciences
Advisors: Prof. Paul Asimow and Prof. Claire Bucholz
- Implement thermodynamic modeling and analytical techniques to understand processes of magmatic differentiation on Earth and Mars.

2019 - 2020 **Universidad Nacional de Colombia, Sede Bogotá**
EPMA Lab Manager, Department of Geosciences
- Trained undergraduate and graduate students on the use of the EPMA and CL microscope for class work and research activities
- Performed daily maintenance and validations to the EPMA
- Developed and maintained analytical standards

2019 **Colorado School of Mines, CO, USA**
Visiting Research Scholar
Advisor: Prof. Richard Palin
- Performed thermodynamic calculations of mineral equilibria in basaltic rocks
- Constructed phase diagrams for Martian, Venusian, and terrestrial rocks

2017 - 2020 **Universidad Nacional de Colombia, Sede Bogotá**
Researcher, Group of applied techniques to tectonics and Basin Analysis
Advisor: Prof. Carlos Zuluaga
- Performed phase equilibria and petrological modeling to study the evolution of the continental crust
- Used electron probe micro–analyzer (EPMA) to analyze major and trace-element distribution in garnet and to perform geothermobarometric calculations in high-grade metamorphic rocks

2016 - 2018 **Universidad La Gran Colombia, Bogotá**
Lab Manager, Laboratory of Geographic Information Systems
- Performed mapping and assessment of environmental and urban variables required for academic projects

2015 **Purdue University, IN, USA**
Visiting Undergraduate Researcher, Lithospheric Tectonics Lab
Advisor: Prof. Chris Andronicos and Prof. Ruth Aronoff
- Used optical microscope for rock classification, mineral identification in thin sections
- Constructed phase diagrams for high-grade metamorphic rocks
- Interpreted geochemical data to calculate a mass balance

2014 - 2015 **Universidad Nacional de Colombia, Sede Bogotá**
Undergraduate Researcher at Lithological Characterization Lab
Advisor: Prof. Carlos Zuluaga
- Used optical microscope, XRD and electron probe micro–analyzer (EPMA) to characterize metamorphic rocks
- Prepared petrographic thin sections and samples for XRD analysis.
- Acquired and interpreted XRD data

TEACHING AND ADVISING EXPERIENCE

ADVISED STUDENTS

2025 - Present Melissa Acevedo Roldán. Universidad Nacional de Colombia, Sede Bogotá, Colombia. Project: "The divergent fate of the crust in rocky planets with distinct compositions."

2025 - Present Emmanuel Maldonado. Universidad Industrial de Santander, Bucaramanga, Colombia. Project: "Crystallization and degassification of magmas in the Martian crust."

2025 - Present Jasmine Cha. High-school student visiting Caltech for summer research project. Project: "Oxidation state of garnets in lower-crust xenoliths from the Northern Andes".

2023 - Present Michael Andres Avila. Universidad Nacional de Colombia, Sede Bogotá, Colombia
Master's thesis co-advisor. Project: "Pre-Jurassic mylonite schists and gneisses of the northwestern flank of the Sierra Nevada de Santa Marta: Deformation phases, metamorphic events and tectonic significance."

2024 Katherine Carvajal Bohorquez. Universidad Industrial de Santander, Bucaramanga, Colombia
Undergraduate thesis co-advisor. Project: "Morphological Characterization of Lava Flows and Pateras in the Jovian Satellite Io using Remote Sensing and Terrestrial Analogues."

TEACHING

2022 - Present **California Institute of Technology, CA, USA**
Teaching Assistant:
- Introduction to Field Geology (Spring 2025)
- Introduction to Geology and Geochemistry / Introduction to Earth and Planetary Sciences: Earth as a Planet (Fall 2023)
- Analytical Techniques Laboratory (Winter 2023)
- Earth and Environment (Fall, 2022)

2019 - 2021 **Universidad Nacional de Colombia, Sede Bogotá**
Instructor, Igneous and Metamorphic Petrology field course.
- Planned and taught a two-week mapping and sampling fieldtrip for the Igneous and Metamorphic Petrology courses at the Universidad Nacional de Colombia.

EPMA Instructor, Department of Geosciences
- Trained undergraduate and graduate students on the use of the EPMA and CL microscope for class work and research activities

2016 - 2018 **Universidad La Gran Colombia Bogotá**
Associate Instructor, Laboratory of Geographic Information Systems
Taught cartography and GIS to undergraduate students of Architecture and Civil Engineering

2012 - 2014 **Universidad Nacional de Colombia, Sede Bogotá**
Teaching Assistant:
- Metamorphic Petrography (2014)
- Mineralogy (2013)
- Descriptive Geometry (2012)
- Geodynamics (2012)

PRESENTATIONS AND CONFERENCE PAPERS (PRESENTING AUTHOR ONLY)

Bucholz C.E., ***Hernández-Montenegro, J.D.** (2024) Secular shifts in oxygen isotopes of peraluminous granites. Goldschmidt 2024, USA (*Presenting author). *Invited speaker*

Hernández-Montenegro, J.D., Kizovski T.V., Li A.Y., Labrie J., Liu Y., Treiman A.H., Schmidt M.E., Asimow P.D., Pedersen D.A.K., Brown A.J., Herd C.D.K., and the PIXL team. (2023) The petrogenesis of Quartier: An evolved olivine cumulate rock in the Séítah Formation (Jezero crater, Mars) LPSC 2023, USA

Hernández-Montenegro, J.D., Asimow, P.D., Herzberg C. (2022) PRIMARSMELT: Calculating primary magma compositions for Mars. Goldschmidt 2022, USA

*Bucholz C.E., **Hernández-Montenegro, J.D.**, Sosa E.S., Tissot F.L.H., Kipp M.A. (2022) Fractionation of iron isotopes between S-type granites and their sedimentary sources: a case study of the Ghost Lake Batholith. Goldschmidt 2022, USA (*Presenting author)

Hernández-Montenegro, J.D., Palin R., Zuluaga C.A. (2019) "Building Continental Crust in a stagnant-lid tectonic regime: An interplanetary perspective". 2019 GSA Annual Meeting in Phoenix, Arizona, USA

Hernández-Montenegro, J.D., Zuluaga C.A., Palin R. (2019) "Production of Archean TTG magmas by partial melting of metabasaltic rocks". Memoirs of the XVII Colombian Geological Congress, Santa Marta, Colombia.

Hernández-Montenegro, J.D., Andronicos C. (2016) "Chemistry of migmatization processes through isocon analysis mass balance". XII Technical Week of Geology and Geological Engineering, Medellin, Colombia

Hernández-Montenegro J.D., Montaño J.C. (2016) "Landslide susceptibility zones predicted by Fuzzy Set Theory and GIS". XII Technical Week of Geology and Geological Engineering, Medellin, Colombia

Hernández-Montenegro J.D., Andronicos C., Aronoff R., Zuluaga C.A. (2015) "Geochemical and petrological characterization of migmatite and restite in the Wet Mountains, Colorado". 2015 GSA Annual Meeting in Baltimore, Maryland, USA

Hernández-Montenegro J.D., Flórez J., Zuluaga C.A., Bonilla G., Ramírez T.A., Martínez D., Aldana J., Peláez J. (2015) "Petrographic and mineralogical characterization of the Guaca-La Virgen metasedimentary rocks in Santander Massif, Colombia". Memoirs of the XV Colombian Geological Congress, Bucaramanga, Colombia.

Hernández-Montenegro J.D., Montaño J.C. (2015) "Mapping and assessment of landslide susceptibility using Fuzzy Set Theory and GIS, in Sumapaz River Basin, Cundinamarca, Colombia" Memoirs of the XV Colombian Geological Congress, Bucaramanga, Colombia.

FIELD EXPERIENCE

2022	Assynt region, NW Scotland. Two-week field mapping course in NW Scotland invited by the University of Oxford, Department of Earth Sciences. Mapped Precambrian lithological units and structures in the Lewisian Complex.
2022	Owens Valley, California, USA Ten-day field mapping study of fault scarps and grabens conducted for Caltech's Advanced Field Geology course.
2021	Baja California, México Two-week field mapping and sampling of high-pressure rocks from the Bahía Tortugas, Puerto Nuevo, and Bahía Asunción regions.
2019	Eastern Cordillera of Colombia, Santander, Colombia Planned and taught a two-week mapping and sampling fieldtrip for the Igneous and Metamorphic Petrology courses at the Universidad Nacional de Colombia.
2016	Sierra Nevada de Santa Marta Range, Colombia Four-week independent mapping course for the Universidad Nacional de Colombia. Mapped Cretaceous to Proterozoic units near to the Southern region of the Sierra Nevada de Santa Marta Range (Northern Colombian Andes).
2016	Western Cordillera and Central Cordillera, Colombia Two-week mapping and recognition of lithological units for the Geology of Colombia and Mineral Ore Deposits courses, Universidad Nacional de Colombia.
2015	Eastern Alaska Range Three-week field assistant in mapping and sampling project in the Eastern Alaska Range, USA. Purdue University.
2012 - 2015	Eastern Cordillera, Santander Massif; Sierra Nevada del Cocuy, and Boyacá regions, Colombia Four distinct two-week mapping courses for the Geology program at the Universidad Nacional de Colombia: (Introduction to Geology, Structural Geology, Igneous and Metamorphic Petrology, and Stratigraphy and Paleontology)
2014	Nevado del Ruiz and Cerro Machín Volcanoes in the Central Cordillera of Colombia Three-week mapping and recognition of lithological units for the Volcanology course, Universidad Nacional de Colombia.

TECHNICAL PROFICIENCIES

- Analytical techniques: Neptune MC-ICP-MS; Electron probe micro-analyzer EPMA JEOL (JXA-8230); SIMS; Laser fluorination; X-Ray Diffractometer – Bruker D2 phaser; Optical mineralogy; Thin section preparation.
- Modeling Software: PHREEQC; MELTS; Perple_X; Theriak-Domino; Thermocalc; ASPECT; StagYY.
- Programming: Python; MATLAB; R.
- GIS Software: ArcGIS, QGIS.

OUTREACH AND SERVICE

2024 - Present **Club of Students from Latin America at Caltech, Caltech**
President and Founder

2023 - Present **Union Station Adopt-a-meal program**
Volunteer, Caltech Y

Leader and team member every month's meal service for residents of the Pasadena Union Station Homeless Services organization.

2024 - Present **Donde se oculta el sol Natural Reserve, Putumayo, Colombia**
Volunteer and Science Collaborator
Helped in planning and execution of different activities in the reserve, including nature walks, bird watching, and plant-based cooking.

2022 **ScienteLab, Colegio de la Bici**
Mentor
Teamed up with a group of third-grade students from a public school in an underserved community in Bogotá on a hands-on composting project. The students designed their own compost bins, collected food scraps from their homes, and learned about the decomposition process while exploring the connection between composting and climate change. This project was showcased at the STEM Olympiads in Bogotá.

2013 - 2016 **Universidad Nacional de Colombia, Sede Bogotá**
Volunteer, COMFIE Program
Developed strategies to prevent students from dropping out. Participated in activities aimed to improve academic conditions for first- and second-year university students. Counseled students with academic questions and undertook administrative tasks.

PAPER REVIEWS

Geochimica et Cosmochimica Acta, *Earth and Planetary Science Letters*, *Lithos*, *Journal of Geophysical Research: Planets*. *Geoscience Frontiers*.