# BRETT B. CARR, Ph.D.

University of Arizona • Lunar and Planetary Laboratory
1629 E. University Blvd • Tucson, AZ 85721 • Phone: (405) 473-5512
Email: bbcarr@arizona.edu • Website: https://bcarr07.wixsite.com/brettcarr

Curriculum Vitae

## OVERVIEW

I am a volcanologist studying the physical processes driving volcanic eruptions. I combine observational and numerical modeling techniques towards my primary goal of building a more complete understanding of active volcanism. I develop new ways to collect and analyze remote sensing observations to better capture volcanic eruption processes. I am particularly interested in the eruptive cycles of persistently active volcanoes and the drivers of changes in activity style.

## EDUCATION

**2016** **Ph.D. Geological Sciences, Arizona State University**
*Transitions in Eruption Styles at Silicic Volcanoes: From Stable Domes to Pyroclastic Flows and Explosive Plumes*
Principal Advisor: A. B. Clarke

**2008** **M.S. Geophysics, University of Wisconsin at Madison**
*Geodetic Measurements and Numerical Models of Rifting in Northern Iceland for 1993-1999*
Principal Advisor: K. L. Feigl

**2007** **B.A. Earth Science, Dartmouth College**
*Mobility of Experimental Gravity Surges Over Ridge-like Obstacles*
Principal Advisor: W. B. Dade

## PROFESSIONAL APPOINTMENTS

**2022-** **Researcher/Scientist III**, Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ

**2020-2021** **Mendenhall Postdoctoral Research Fellow**, Hawaiian Volcano Observatory, United States Geological Survey, Hilo, HI

**2017-2019** **National Science Foundation Postdoctoral Research Scientist**, Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY

**2017** **Student Contractor**, Astrogeology Science Center, United States Geological Survey, Flagstaff, AZ

**2010** **Park Ranger (Geologist)**, Yellowstone Center for Resources, Yellowstone National Park, WY

## PUBLICATIONS

### Refereed Articles

11) **Carr, B. B.**, E. Lev, D. Moyer, L. Vanderkluysen, G. I. Marliyani, A. B. Clarke (2022). The stability and collapse of lava domes: insight from photogrammetry and slope stability models applied to Sinabung Volcano (Indonesia). *Frontiers in Earth Science* 10:813813, doi: 10.3389/feart.2022.813813

10) **Carr, B. B.,** E. Lev, T. Sawi, K. A. Bennett, C. S. Edwards, S. A. Soule, S. Vallejo Vargas, G. I. Marliyani (2021). Mapping and classification of volcanic deposits using multi-sensor

unoccupied aerial systems. *Remote Sensing of Environment*, 264(112581), doi: 10.1016/j.rse.2021.112581

9) Civico, R., T. Ricci, P. Scarlato, D. Andronico, M. Cantarero, **B. B. Carr**, E. De Beni, E. Del Bello, J. B. Johnson, U. Küppers, L. Pizzimenti, M. Schmid, K. Strehlow, J. Taddeucci (2021). Unoccupied aircraft systems (UASs) reveal the morphological changes at Stromboli volcano (Italy) before, between, and after the 3 July and 28 August 2019 paroxysmal eruptions. *Remote Sensing* 13, 2870, doi: 10.3390/rs13152870

8) James, M. R., **B. B. Carr**, F. D'Arcy, A. K. Diefenbach, H. R. Dietterich, A. Fornaciai, E. Lev, E. J. Liu, D. C. Pieri, M. Rodgers, B. Smets, A. Terada, F. W. von Aulock, T. R. Walter, K. T. Wood, E. U. Zorn (2020). Volcanological applications of unoccupied aircraft systems (UAS): Developments, strategies, and future challenges. *Volcanica*, 3(1), 67-114, doi: 10.30909/vol.03.01.67114

7) **Carr, B. B.**, A. B. Clarke, M. de' Michieli Vitturi (2020). Volcanic conduit controls on effusive-explosive transitions and the 2010 eruption of Merapi Volcano (Indonesia). *Journal of Volcanology and Geothermal Research*, 392, 106767, doi: 10.1016/j.jvolgeores.2019.106767

6) **Carr, B. B.**, A. B. Clarke, J R. Arrowsmith, L. Vanderkluysen (2019). Mechanisms of lava flow emplacement during the effusive eruption of Sinabung Volcano (Sumatra, Indonesia). *Journal of Volcanology and Geothermal Research,* 382, 137-148, doi: 10.1016/j.jvolgeores.2018.03.002

5) **Carr, B. B.**, A. B. Clarke, J R. Arrowsmith, L. Vanderkluysen, B. Eko Dhanu (2019). The emplacement of the active lava flow at Sinabung Volcano, Sumatra, Indonesia, documented by structure-from-motion photogrammetry. *Journal of Volcanology and Geothermal Research,* 382, 164-172, doi: 10.1016/j.jvolgeores.2018.02.004

4) **Carr, B. B.**, A. B. Clarke, and M. de' Michieli Vitturi (2018). Extrusion rate variations during dome-forming eruptions: a numerical modeling approach to the 2006 eruption of Merapi Volcano (Indonesia). *Earth and Planetary Science Letters,* 482, 377-387, doi: 10.1016/j.epsl.2017.11.019

3) Polacci, M., M. de' Michieli Vitturi, *et al.* including **B. B. Carr** (2017). From magma ascent to ash generation: investigating volcanic conduit processes by integrating experiments, numerical modeling, and observations. *Annals of Geophysics,* 60(6), S0666, doi: 10.4401/ag-7449

2) **Carr, B. B**., A. B. Clarke, L. Vanderkluysen (2016). The 2006 lava dome eruption of Merapi Volcano (Indonesia): detailed analysis using MODIS TIR. *Journal of Volcanology and Geothermal Research,* 311, 60-71, doi: 10.1016/j.jvolgeores.2015.12.004

1) Ali, S. T., K. L. Feigl, **B. B. Carr**, T. Masterlark, and F. Sigmundsson (2014). Geodetic measurements and models of rifting in Northern Iceland for 1999-2008. *Geophysics Journal International,* 196(3), 1267-1280, doi: 10.1093/gji/ggt462

**Other Publications**

**Carr, B. B.**, C. Jaworowski, H. P. Heasler (2010). It's not Drying Up, Just Changing: Mapping Change at Mammoth Hot Springs Using Aerial Photographs and Visual Observations. *Yellowstone Science,* 18(3), 15-22.

**Manuscripts in Preparation**

**Carr, B. B.,** M. R. Patrick, H. R. Dietterich, M. H. Zoeller, C. E. Parcheta, D. T. Downs, P. A. Nadeau, C. W. Hamilton (*to be submitted to Bulletin of Volcanology)*, Growth of a passive lava lake during the 2020-2021 eruption of Kīlauea volcano, Hawai'i.

**Carr, B. B.,** M. Varnam, N. Hadland, J. Shah, K. Stack, R. Francis, F. Calef, S. Gwizd, J. R. C. Voigt, U. Basu, B. Björnsson, C. Chen, E. Dong, J. Graff, S. M. Hibbard, J. E. Moersch, M. Phillips, J. Springer, C. D. Neish, C. W. Hamilton (*to be submitted to Planetary Science Journal)*, Evaluating the use of unoccupied aircraft systems (UAS) for planetary surface exploration in analog terrain.

Gwizd, S., K. M. Stack, R. Francis, F. Calef, **B. B. Carr**, C. Langley, G. Tolometti, J. Graff, T. H. Kristinsson, V. P. Thorarensen, E. Bernhardsson, M. Phillips, M. Varnam, J. Shah, J. Moersch, U. Basu, J. R. C. Voigt, C. W. Hamilton (*to be submitted to Planetary Science Journal)*, Comparing rover and unoccupied aircraft system (UAS) planetary mission architectures in a Mars analog setting in Iceland.

Shah, J., **B. B. Carr**, M. Varnam, N. Hadland, J. R. C. Voigt, C. D. Neish, K. Seelos, C. W. Hamilton *(to be submitted to Planetary Science Journal)*, Lessons learned from RAVEN: Applications for future operational procedures for Unoccupied Aircraft Systems (UAS) missions.

Gallant, E., H. R. Dietterich, M. R. Patrick, D. Hyman, J. Lyons, **B. B. Carr**, Catastrophic lava flow levee failure: precursors, processes, and implications

**Data Publications**

Patrick M. R., C. Parcheta, P. Nadeau, D. Downs, M. Zoeller, K. J. Lynn, F. Trusdell, E. F. Younger, A. Ellis, P. Dotray, K. Mulliken, **B. B. Carr**, 2023. Colorimeter data for the summit water lake at Kīlauea Volcano, Island of Hawai'i, 2020. U.S. Geological Survey data release https://doi.org/10.5066/P95WBNRV

**Carr, B. B.**, A. L. LeWinter, D. C. Finnegan, M. H. Zoeller, M. R. Patrick, 2023, Rapid-response digital elevation models of the 2020-present summit eruptions at Kīlauea Volcano, Island of Hawai'i: U.S. Geological Survey data release. https://doi.org/10.5066/P99NLP4E

Hamilton, C. W., **B. B. Carr**, J. R. C. Voigt (2022). Fagradalsfjall (Iceland) 2021 Eruption Unoccupied Aircraft Systems (UAS) Data: Surveys. University of Arizona Research Data Repository. Dataset. https://doi.org/10.25422/azu.data.21071140.v1

Hamilton, C. W., B. Óskarsson, G. Valsson, M. S. Christoffersen, J. R. C. Voigt, W. Moreland, N. Hadland, A. Kubas, **B. B. Carr** (2022): Fagradalsfjall (Iceland) 2021 Eruption Ground Control Points (GCPs). University of Arizona Research Data Repository. Dataset. https://doi.org/10.25422/azu.data.21084865.v1

**Carr, B. B.** (2021). Sinabung Volcano (Indonesia), June 20, 2018. Distributed by OpenTopography. https://doi.org/10.5069/G9988568

**Carr B. B.**, (2020): Sierra Negra Volcano (TIR Flight 3): Galápagos, Ecuador, October 22 2018. Distributed by OpenTopography. https://doi.org/10.5069/G957196P

**Carr B. B.**, (2020): Sierra Negra Volcano (TIR Flight 2): Galápagos, Ecuador, October 22 2018. Distributed by OpenTopography. https://doi.org/10.5069/G92F7KMS

**Carr B. B.**, (2020): Sierra Negra Volcano (TIR Flight 1): Galápagos, Ecuador, October 22 2018. Distributed by OpenTopography. https://doi.org/10.5069/G9668BBH

**Carr B. B.**, (2020): Sierra Negra Volcano (Visual): Galápagos, Ecuador, October 22 2018. Distributed by OpenTopography. https://doi.org/10.5069/G99Z932X

**Carr B. B.**, (2019): LUSI Mud Volcano July 1, 2018. Distributed by OpenTopography. https://doi.org/10.5069/G9Q81B6D

**Carr, B. B.** (2019). Stromboli Volcano: September 12, 2018 (Vent area only). Distributed by OpenTopography. https://doi.org/10.5069/G9R49NXH

**Carr, B. B.** (2019). Stromboli Volcano: September 10, 2018 (Vents & Sciara del Fuoco). Distributed by OpenTopography. https://doi.org/10.5069/G9VX0DNG

**Carr, B. B.** (2019). Sinabung Volcano September 2014: Model 1. Distributed by OpenTopography. https://doi.org/10.5069/G9N29V25

**Carr, B. B.** (2019). Sinabung Volcano September 2014: Model 2. Distributed by OpenTopography. https://doi.org/10.5069/G9H993BT

**Carr, B. B.** (2019). Sinabung Volcano September 2014: Model 3. Distributed by OpenTopography. https://doi.org/10.5069/G9CJ8BM3

**Carr, B. B.** (2019). Sinabung Volcano September 2014: Model 4. Distributed by OpenTopography. https://doi.org/10.5069/G97S7KWC

## GRANTS & FELLOWSHIPS

**2023-2026** **Co-I, NASA/Solar System Workings (SSW)**, "Exploring the origin and eruption of silicic lunar volcanic deposits through the Wildcat Hills, Utah: A terrestrial analog study" (PI: K. Bennett), $99,114.

**2022-2025** **Co-I, NASA/Decadal Survey Incubation**, "STV Volcano Science and Applications Needs" (PI: P. Lundgren), $110,126.

**2020-2021** **USGS/Mendenhall Postdoctoral Fellowship**, "Towards improved hazard assessments for large effusive eruptions: Lava flow advance during the 2018 Kīlauea Lower East Rift Zone eruption", $200,760.

**2017-2019** **PI, NSF/Earth Sciences Postdoctoral Fellowship** (EAR-1725768), "The Stability of Viscous Lavas: Understanding the Driving Processes and Greatest Hazards", $174,000.

## TEACHING

Arizona State University

Teaching Assistant in the School of Earth and Space Exploration 2010-2016

*Courses as Primary Instructor:*

GLG 103: Introduction to Geology Laboratory (Fall 2010, Spring 2011, Fall 2012)

GLG 111: Dangerous World Laboratory (10 times between Spring 2012 and Summer 2016)

SES 123: Earth, Solar System, & Universe Laboratory I (as geology co-instructor)

*Courses as Teaching Assistant:*

GLG 101: Introduction to Geology (Fall 2011, Fall 2013)

GLG 110: Dangerous Worlds (11 times between Fall 2011and Summer 2016)

GLG 452: Field Geology II (Summer 2011, 2012, 2013)
SES 121: Earth, Solar System, & Universe I (Fall 2015)

University of Arizona
*Courses as Field Trip Co-Lead*
PTYS 590: Planetary Geology Field Studies (Spring 2023)

Guest Lectures
University of Arizona: RNR 422 (Resource Mapping Using Unmanned Aircraft Systems)
University of Arizona: GEOS 411 (Geology and Geophysics of the Solar System)
University of Arizona: GEOS 470R (Planetary Volcanism)
Columbia University: EESC 1011 (Earth: Origin, Evolution, Processes, Future), April 2019
Colorado School of Mines: GPGN 101 (Introduction to Geophysics: Geophysics & Society), April 2020

## ORAL PRESENTATIONS

### Invited Talks

**2023** "Volcanic deposits and the eruptions that created them: a remote sensing perspective", Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ, September 19.

**2023** Early Career Researcher Plenary Talk: "The hazards and driving processes of lava dome collapse: insight from the eruption of Sinabung Volcano (Indonesia)", IAVCEI Scientific Assembly, Rotorua, New Zealand, January 31.

**2022** "Lava dome instability and collapse: insight from Sinabung Volcano", Focus Group Discussion on Merapi Volcano Hazard Assessment, Yogyakarta, Indonesia (given Virtually), September 6.

**2021** "Drones at Volcanoes: New perspectives for science and hazards", Department of Biodiversity, Earth and Environmental Science, Drexel University Philadelphia, PA (given virtually), October 14.

**2020** "Mapping and classification of volcanic deposits using multi-sensor unoccupied aerial systems", International Volcanology Seminar (Virtual), August 4.

**2020** "Towards improved hazard assessments for effusive eruptions: Measuring and modeling lava flow advance", USGS Volcano Science Center Seminar (Virtual), April 29.

**2018** "Structure-from-Motion Photogrammetry Applications to the Geosciences", Department of Geological Engineering, Sekolah Tinggi Teknologi Nasional (STTNAS), Yogyakarta, Indonesia, July 4.

**2018** "Structure-from-Motion Photogrammetry Applications to the Geosciences", Geological Engineering Department, Faculty of Engineering, Universitas Gadjah Mada, Yogyakarta, Indonesia, July 3.

**2018** "Structure-from-Motion Photogrammetry Applications to the Geosciences", Department of Biodiversity, Earth and Environmental Science, Drexel University Philadelphia, PA, April 11.

**2018** "Lava Flow Emplacement During the Ongoing Eruption of Sinabung Volcano, Sumatra, Indonesia", Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, January 29

**2016** "Lava Flow Emplacement During the Ongoing Eruption of Sinabung Volcano, Sumatra, Indonesia", Laboratoire Magmas et Volcans, Université Blaise Pascal, Clermont-Ferrand, France, September 19.

**Conference Talks**

**2023** "Evaluating the use of unoccupied aircraft systems (UAS) for planetary surface exploration in analog terrain", Lunar and Planetary Laboratory Conference, Tucson, AZ, August 17.

**2023** "Vent construction and erosion observed by UASs during 2021-2022 at Fagradalsfjall, Iceland" IAVCEI Scientific Assembly, Rotorua, New Zealand February 3.

**2021** "Applications of UAS thermal infrared cameras to volcanic and geothermal processes", NASA ESI and ESTO UAS Workshop (Virtual), March 10.

**2018** "Multiple Causes of Dome Collapse During the Prolonged Effusive Eruption of Sinabung Volcano, Indonesia", Cities on Volcanoes 10, Naples, Italy, September 6.

**2018** "Investigating the Emplacement and Collapse of Higher Viscosity Lava with Structure-from-Motion Photogrammetry", Virtual Geoscience Conference, Kingston, Ontario, Canada, August 24

**2016** "Photogrammetry Applications for Active Volcanism", Workshops on Volcanoes, Quetzaltenango, Guatemala, January 5.

**2015** "The Ongoing Lava Flow Eruption of Sinabung Volcano (Sinabung, Indonesia): Observations from Structure-from-Motion and Satellite Remote Sensing", AGU Fall Meeting, San Francisco, CA, December 14.

## FIELD EXPERIENCE

**2023** Fagradalsfjall Volcano, Iceland
Lava flow emplacement processes during an ongoing eruption (UAS photogrammetry)

**2022** Fagradalsfjall Volcano, Iceland
Lava flow emplacement processes during an ongoing eruption (UAS photogrammetry)

**2022** Holuhruan, Iceland
UAS Science Operations Lead for the RAVEN (Rover and Aerial Vehicle Exploration Network) NASA PSTAR project simulating a joint UAS-Rover Mars mission.

**2020-2021** Kīlauea Volcano, Hawai`i
Conducted volcano monitoring operations as member of Hawaiian Volcano Observatory staff. Part of field and helicopter overflight teams responding to eruptions. Lead for photogrammetric processing to produce DEMs and other data products as part of eruption response.

**2019** Merapi Volcano, Java, Indonesia
Lava dome growth and collapse processes (UAS photogrammetry)

**2018** Sierra Negra Volcano, Galápagos, Ecuador
Lava flow emplacement (UAS photogrammetry)

**2018** Stromboli Volcano, Italy
Strombolian eruption processes (UAS photogrammetry; thermal imaging)

**2018** Sinabung Volcano, Sumatra, Indonesia
Stability of erupted lava (UAS photogrammetry)

**2018** Kīlauea Volcano, Hawai`i
Crisis response in support of Civil Defense efforts during the Kilauea Lower East Rift Zone eruption (UAS visible light and thermal monitoring)

**2016** Santiaguito Volcano, Guatemala
Workshops on Volcanoes: multi-scale simultaneous observations (photogrammetry)

**2014** Sinabung Volcano, Sumatra, Indonesia
Emplacement of an active andesite lava flow (ground-based photogrammetry)

**2014** San Francisco Volcanic Field, Arizona, USA
Photogrammetry methods development, mentor for ASU NSF REU students

**2011** Yellowstone National Park, Wyoming, USA
Structural controls on geothermal features (mapping, geochemical sampling)

**2006** Dominica
REU participant, deformation of active volcanic systems (campaign GPS survey)

## WORKSHOP PARTICIPATION

**2023** **Co-Instructor,** Planetary Data Training Workshop – Planetary Photogrammetry, Tucson, AZ, September 12-15.

**2023** **Co-Instructor,** Planetary Data Training Workshop – Planetary GIS, Tempe, AZ, August 8-11.

**2023** **Co-Instructor,** Planetary Data Training Workshop – Planetary GIS, Tempe, AZ, May 23-26.

**2023** CONVERSE Planning a Future, Portland, OR (attended virtually)

**2023** Lessons-Learned Community-Driven Workshop to Define Best Practices for Unoccupied Aerial Systems (UAS) use in Volcanology, IAVCEI Scientific Assembly, Rotorua, New Zealand

**2022** SZ4D Community Meeting, Houston, TX

**2022** CONVERSE Distributed Volcanism Eruption Scenario Workshop (Virtual)

**2021** **Invited Speaker,** NASA ESI and ESTO UAS Workshop (Virtual)

**2021** High Performance Computing for Python Workshop, organized by USGS Advance Research Computing (Virtual)

**2021** International Workshop on Volcano Monitoring Infrastructure on the Ground and In Space (Virtual)

| | |
|---|---|
| **2021** | SZ4D Modeling Collaboratory for Subduction Volcanic Systems Modeling Workshop (Virtual) |
| **2021** | Computational Infrastructure for Volcanology workshop (Virtual) |
| **2021** | Workshop on Novel Instrumentation to Anticipate Volcanic Eruptions, organized by the Anticipating Volcanic Eruptions in Real-Time (AVERT) project (Virtual) |
| **2020** | CONVERSE Virtual Eruption Scenario Workshop (Virtual) |
| **2018** | Workshop on Advancing Integrative Volcanology with Community Experiments, Albuquerque, NM |
| **2018** | Broadband Acquisition and Imaging Operation (BAcIO) Workshop, Stromboli, Italy |
| **2018** | Early-Career Workshop: Forming and Enhancing Partnerships between Scientists and Stakeholders, Cities on Volcanoes 10 Conference, Naples, Italy |
| **2016** | The Subduction Zone Observatory Workshop, organized by the Incorporated Research Institutions for Seismology (IRIS), Boise, Idaho |
| **2016** | **Principal Scientist,** Workshops on Volcanoes, Quetzaltenango, Guatemala |
| **2014** | From Magma Ascent to Ash Generation: Investigating Volcanic Conduit Processes by Integration of Experiments, Numerical Modeling and Observations", organized by Measuring and Modeling of Volcano Eruption Dynamics (MeMoVolc), Pisa, Italy |
| **2013** | Magma-Tectonic Interactions in the Americas, organized by the Pan American Advanced Studies Institute (PASI), Leon, Nicaragua |

## AWARDS

| | |
|---|---|
| **2013, 2014, 2015** | School of Earth and Space Exploration Summer Fellowship Award, $3,500 (each year) |
| **2012, 2013, 2014, 2015** | ASU Graduate and Professional Student Association Travel Grant, $950 (each year) |
| **2007** | Graduated with honors in Earth Science, Dartmouth College |

## SERVICE

| | |
|---|---|
| **2023** | **UAS Task Group Lead,** CONVERSE Catalyst Center |
| **2021** | **Proposal Review Panelist,** NASA |
| **2020** | **External Reviewer,** National Science Foundation (EAR-MRI) |
| **2019** | **Contributor,** Global Volcanism Program, Report on Merapi (Indonesia) (Krippner, J.B., and Venzke, E., eds.). *Bulletin of the Global Volcanism Network*, 44:10. Smithsonian Institution. https://doi.org/10.5479/si.GVP.BGVN201910-263250 |
| **2019** | **AGU Session Convener & Chair**, Multiscale observations of volcanic and tectonic activity. Co-conveners: Taryn Lopez, Elise Rumpf, Silvana Hidalgo |
| **2018-2019** | **Organizer**, SGT-MGG Division Weekly Seminar Series, Lamont-Doherty Earth Observatory |

**2018** **AGU Session Convener & Chair**, Applications of Unmanned Aerial Systems (UAS) to the study of volcanic systems. Co-conveners: Emma Liu, Danielle Moyer, Felix von Aulock

**2019** **Contributor,** Global Volcanism Program, Report on Sinabung (Indonesia) (Krippner, J.B., and Venzke, E., eds.). *Bulletin of the Global Volcanism Network*, 43:9. Smithsonian Institution. https://doi.org/10.5479/si.GVP.BGVN201809-261080

**2018-** **Reviewer**, Geology; GSA Bulletin; Journal of Volcanology and Geothermal Research; Geophysical Journal International; Bulletin of Volcanology; Geochemistry, Geophysics, Geosystems; Frontiers in Earth Science; Remote Sensing; International Journal of Remote Sensing; Canadian Journal of Earth Sciences; Progress in Physical Geography; Communications Earth & Environment; PLOS ONE

**2017-2020** **Outstanding Student Paper Award (OPSA) Judge**, AGU Fall Meeting

## OUTREACH

**2019** **Presenter**, Lamont-Doherty Earth Observatory Open House, Palisades, NY

**2018** **Volunteer**, Science in the Park, Flagstaff, AZ

**2018** **Invited Speaker**, 6th Annual Symposium of the Metropolitan Society of Natural Historians, American Museum of Natural History, New York, NY

**2017** **Presenter**, USGS Flagstaff Science Center Open House, Flagstaff, AZ

**2011, 2013, 2015** **Presenter**, SESE Earth and Space Exploration Day, Arizona State University

**2015** **Guest Scientist**, William C Jack Elementary School Science Day

## ADDITIONAL EXPERIENCE

**2009** **GSA Geocorps Intern,** *Geothermal Resource Assistant*, Yellowstone National Park, Wyoming

**2009** **Visitor Services Intern**, National Park Service volunteer through the Student Conservation Association, Guadalupe Mountains National Park, Texas

**2006** **NSF-REU Participant**, "Dynamic Volcanic Systems in Dominica, West Indies", University of Arkansas

## MEMBERSHIPS

Geological Society of America (2004-)
American Geophysical Union (2006-2008, 2011-)
International Association of Volcanology and Chemistry of the Earth's Interior (2012-)

## CERTIFICATIONS

Wilderness First Aid
FAA Part 107 (Remote Pilot, Unmanned Aircraft System)

## MEDIA COVERAGE

**2022** "Hawaii's Mauna Loa erupts for the first time in 38 years. What happens next?", National Geographic, November 28 https://www.nationalgeographic.com/science/article/hawaii-mauna-loa-erupts-largest-active-volcano-reawakens I was interviewed by the author and am quoted in this article covering the onset of the 2022 eruption of Mauna Loa.

**2021** "Three-dimensional mapping of Kīlauea – Volcano Awareness Month 2022 Short Feature", Hawaiian Volcano Observatory, January 13 https://www.usgs.gov/volcanoes/kilauea/news/three-dimensional-mapping-kilauea-volcano-awareness-month-2022-short-feature I am featured in this video describing structure-from-motion photogrammetry and its application at HVO.

**2021** "The refilling of Halema'uma'u Crater", Hawaiian Volcano Observatory, November 24, *Volcano Watch*, https://www.usgs.gov/volcanoes/kilauea/news/volcano-watch-refilling-halemaumau-crater I am the author of this article describing recent eruptions at Kīlauea and how lava is refilling Halema'uma'u after the 2018 collapse.

**2021** "Pau or Paused? What's the difference?", Hawaiian Volcano Observatory, May 27, *Volcano Watch*, https://www.usgs.gov/center-news/volcano-watch-pau-or-paused-what-s-difference My photogrammetry data and observations of the 2020-2021 Kīlauea eruption are featured in this article discussing the cessation of lava effusion at the volcano.

**2020** "Kīlauea's ongoing eruption: a rising lava lake", Hawaiian Volcano Observatory, December 31, *Volcano Watch*, https://www.usgs.gov/center-news/volcano-watch-k-lauea-s-ongoing-eruption-a-rising-lava-lake I contributed as a co-author on this article describing the ongoing eruption at Kīlauea Volcano.

**2020** "Seeing Yellowstone in stereo: The importance of monitoring Yellowstone's thermal areas from aircraft photos", Dr. R Greg Vaughan, February 10, *Caldera Chronicles*, https://volcanoes.usgs.gov/volcanoes/yellowstone/article_home.html?vaid=249 My work with Dr. Vaughan at the USGS Astrogeology Center in 2017 is featured in this weekly article from the Yellowstone Volcano Observatory.

**2018** "When Will This Hawaiian Volcano Stop Erupting?", Daniel Engber, May 29, *Slate*, https://slate.com/news-and-politics/2018/05/hawaiis-kilauea-volcano-is-still-erupting-when-is-it-going-to-stop.html. I was used as the primary source for the content of the article following a phone interview with the author.

**2016** "Nim Xkanul: Reporting Volcanism in Guatemala", Nathaniel Hoffman, 2 April, *The Blue Review*, Boise, ID. http://bigstory.thebluereview.org/santiaguito-volcano-research/. My research is highlighted as part of this story covering the 2016 Workshops on Volcanoes in Guatemala.

## CONFERENCE ABSTRACTS

43) Roman, A. M., P. Lundgren, H. R. Dietterich, **B. B. Carr** (2023), *Optimal topography-change spatiotemporal resolution for forecasting lava flows*, Abstract ID# 1415217, AGU Fall Meeting, San Francisco, CA, 11-15 Dec.

42) Lundgren, P., A. M. Roman, M. G. Bato, **B. B. Carr**, H. R. Dietterich, R. Grandin, T. Shreve, M. P. Poland, K. R. Anderson, F. Delgado (2023), *Volcano science and applications observation needs from*

*future topography missions*, Abstract ID# 1405652, AGU Fall Meeting, San Francisco, CA, 11-15 Dec.

41) Patrick, M. R., M. H. Zoeller, F. A. Trusdell, D. T. Downs, K. J. Lynn, N. I. Deligne, K. Mulliken, E. Gallant, J. M. Chang, J. Schmith, J. Chang, P. Dotray, I. Johanson, P. Nadeau, **B. B. Carr** (2023) *Patterns of crater-refilling eruptions at the summit of Kīlauea, 2020-present*, Abstract ID# 1284836, AGU Fall Meeting, San Francisco, CA, 11-15 Dec.

40) Williams, D. A., S. R. Black, S. Byrne, **B. B. Carr**, C. W. Hamilton, A. G. Hayes, M. A. Hunter, D. M. Nelson, Z. L. Ponterio (2023), *Planetary Data Training Workshops, 2022-2024*, Abstract 7002, 6th Planetary Data Workshop, Flagstaff, AZ, 26-28 Jun.

39) Shah, J., **B. B. Carr,** N. Hadland, M. Varnam, J. R. C. Voigt, C. W. Hamilton, C. Chen, E. Dong, J. Graff, M. Phillips, J. Springer, and C. D. Neish (2023), *Evaluating the use of unoccupied aerial systems (UAS) for planetary surface exploration in analog terrain,* Abstract 1732, Lunar and Planetary Science Conference, The Woodlands, TX, 13-17 Mar.

38) **Carr, B. B.,** C. Hamilton, J. Voigt, W. Moreland, T. Thordarson, Á Höskuldsson, I. Jónsdóttir (2023), *Vent construction and erosion observed by UASs during 2021-2022 at Fagradalsfjall, Iceland,* Abstract 1222, IAVCEI Scientific Assembly, Rotorua, New Zealand, 30 Jan – 3 Feb.

37) Hammer, J., B. Halverson, H. Dietterich, E. Lev, J. Baur, A. Whittington, J. Boro, E. Hellebrand, M. Patrick, J. Birnbaum, **B. B. Carr,** C. Parcheta, M. Zoeller (2023), *Evolution of crystallinity during the 2018 Kīlauea lower East Rift Zone eruption,* Abstract 1092, IAVCEI Scientific Assembly, Rotorua, New Zealand, 30 Jan – 3 Feb.

36) Dietterich, H., M. Patrick, **B. B. Carr**, E. Gallant, D. Hyman, A. Diefenbach, K. Cashman, G. Grant (2022), *New insights into lava flow dynamics and hazards from the 2018 eruption of Kīlauea, Hawai'i,* Geological Society of America Abstracts with Programs, v. 50, no. 5, https://doi.org/10.1130/abs/2022AM-381170, GSA Connects, Denver, CO, 9-12 Oct.

35) Koeppel, A., C. Edwards, H. Eifert, L. Edgar, S. Nowicki, K. Bennett, A. Gullikson, S. Piqueux, A. Rutledge, E. Rampe, **B. B. Carr**, A. D. Rogers (2022), *Using surface temperatures to interpret sediments and volatiles at mars analog sites,* Geological Society of America Abstracts with Programs, v. 50, no. 5, https://doi.org/10.1130/abs/2022AM-377689, GSA Connects, Denver, CO, 9-12 Oct.

34) Zoeller, M., **B. B. Carr**, E. Gallant, L. DeSmither, N. Deligne, D. Downs (2022), *In need of speed: best practices for UAS photogrammetry of active volcanic eruptions*, Abstract WP-12, AGU Chapman Conference on Distributed Volcanism and Distributed Volcanic Hazards, Flagstaff, AZ, 19-23 Sept.

33) **Carr, B. B.**, H. Dietterich, M. Patrick, C. Parcheta, P. Lundgren (2022), *Effect of input topography on lava flow models and implications for hazard assessment*, Abstract 659473, AGU Chapman Conference on Distributed Volcanism and Distributed Volcanic Hazards, Flagstaff, AZ, 19-23 Sept.

32) Koeppel, A., C. Edwards, L. Edgar, S. Nowicki, K. Bennett, **B. B. Carr**, A. Gullikson, S. Piqueux, H. Eifert, A. D. Rogers (2022), *Tracking surface energy flux at analog field sites for thermophysical modeling of Martian sediments*, LPI Contribution No. 2685, id.7001, Optimizing Planetary in Situ Surface-Atmosphere Interaction Investigations Workshop, Boise, ID, 28 Jun – 1 Jul.

31) **Carr, B. B**., M. Patrick, H. Dietterich, M. Zoeller, C. Parcheta, K. Mulliken, P. Nadeau (2021), *Growth of a passive lava lake during the 2020-2021 eruption of Kīlauea volcano*, Abstract V25E-01, AGU Fall Meeting, New Orleans, LA, 13-17 Dec (presented virtually).

30) Patrick, M., F. Younger, W. Tollett, **B. B. Carr,** M. Zoeller, H. Dietterich, P. Dotray, K. Ulmer, J. Chang (2021), *Complex filling processes in a passive lava lake tracked by continuous laser rangefinder, Kīlauea volcano*, Abstract V21A-03, AGU Fall Meeting, New Orleans, LA, 13-17 Dec.

29) Gallant, E., H. Dietterich, M. Patrick, **B. B. Carr**, D. Hyman (2021), *Reconstructing the Ahalanui flow branching event of the 2018 Lower East Rift Zone eruption of Kīlauea (Hawai'i, USA)*, Abstract V35F-03, AGU Fall Meeting, New Orleans, LA, 13-17 Dec.

28) Halverson, B., A. Whittington, S. Kenderes, J. Hammer, H. Dietterich, E. Lev, E. Llewellin, M. Patrick, **B. B. Carr**, M. Zoeller, C. Parcheta, J. Birnbaum, J. Baur (2021), *Correlation of calculated cooling rates with textural variations of the fissure 8 flow field, Kīlauea 2018: A method for determination of primary and secondary textures*, Abstract V35F-07, AGU Fall Meeting, New Orleans, LA, 13-17 Dec.

27) **Carr, B. B**., M. Patrick, H. Dietterich, C. Parcheta (2020), *Towards improved hazard assessments for large effusive eruptions: Lava flow advance during the 2018 Kīlauea Lower East Rift Zone eruption*, Abstract V002-0015, AGU Fall Meeting (Virtual), 1-17 Dec.

26) Halverson, B., A. Whittington, J. Hammer, R. Degraffenried, E. Lev, H. Dietterich, M. Patrick, **B. B. Carr**, M. Zoeller, F. Trusdell, E. Llewellin (2020), *Vesicularity, crystallinity, and implications for rheology of the Kīlauea 2018 Lava Flows*, Abstract V002-0016, AGU Fall Meeting (Virtual), 1-17 Dec.

25) Dietterich, H., A. Diefenbach, M. Zoeller, M. Patrick, **B. B. Carr** (2020), *Lava flow forecasting aided by remote sensing during the 2018 Kīlauea lower East Rift Zone eruption*, Abstract V029-02, AGU Fall Meeting (Virtual), 1-17 Dec.

24) Patrick, M., H. Dietterich, C. Parcheta, M. Zoeller, **B. B. Carr** (2020), *New insights into lava flow dynamics during the 2018 eruption of Kīlauea,* Abstract V002-0009, AGU Fall Meeting (Virtual), 1-17 Dec.

23) Halverson, B., A. Whittington, J. Hammer, R. DeGraffenried, E. Lev, J. Birnbaum, H. Dietterich, M. Patrick, C. Parcheta, **B. B. Carr**, M. Zoeller, F. Trusdell, E. Llewellin (2020), *Vesicularity, crystallinity, and implications for rheology of the Kīlauea 2018 lava flows,* Abstract 32-2, GSA Connects (Virtual), 26-30 Oct.

22) **Carr, B. B**., E. Lev, L. Vanderkluysen, D. K. Moyer, G. I. Marliyani and A. B. Clarke (2019), *The stability and collapse of lava domes: Insight from UAS-derived 4D structure and slope stability models*, Abstract V31H-105, AGU Fall Meeting, San Francisco, CA, 9-13 Dec.

21) Soule, S. A., L. Karlstrom, E. Lev, **B. B. Carr**, M. Jones, S. Vallejo Vargas, M. D. Córdova Aguilar, D. Mikesell, J. Paustian, A. Kubo, A. P. Michel, W. Pardis (2019), *Multiscale and multisensor mapping of the 2018 Sierra Negra eruption, Galápagos, Ecuador*, Abstract V23C-02, AGU Fall Meeting, San Francisco, CA, 9-13 Dec.

20) Moyer, D. K., L. Vanderkluysen, **B. B. Carr**, A. Harijoko, H. Wibowo, E. Handini (2019), *In situ particle sampling and size analysis via unmanned aerial systems in volcanic clouds: examples from Sinabung*

*and Merapi volcanoes, Indonesia,* Abstract V23G-0285, AGU Fall Meeting, San Francisco, CA, 9-13 Dec.

19) **Carr, B. B.**, Lev, E., Bennett, K. A., Edwards, C. S., Soule, S. A., Vallejo Vargas, S. (2019), *Mapping and classification of volcanic deposits using multi-sensor Unoccupied Aerial Vehicles.* New York Scientific Data Summit, New York City, NY, 12-14 Jun.

18) **Carr, B. B.**, Bennett, K. A., Lev, E., Edwards, C. S. (2019), *Utilization of an sUAS-based thermal camera to determine relative thermal inertia of volcanic deposits*, Abstract No. 3129, Lunar and Planetary Science Conference, The Woodlands, TX, 18-22 Mar.

17) **Carr, B. B**., E. Lev (2018), *Activity and Hazards of the Ongoing Eruption of Sinabung Volcano, Indonesia, evaluated using UAS-derived datasets,* Abstract V23D-0108, AGU Fall Meeting, Washington, DC, 10-14 Dec.

16) Smekens, J.-F., C. R. Sealing, E. Carey, L. Vanderkluysen, **B. B. Carr**, G. I. Marliyani, A. Harijoko, C. S. Edwards (2018), *Contrasting Degassing Behaviors Before and After a Shift in Eruptive Style at Sinabung Volcano, Indonesia,* Abstract V23K-0188, AGU Fall Meeting, Washington, DC, 10-14 Dec.

15) Lev, E., J. Oppenheimer, **B. B. Carr**, R. L. Perroy, H. R. Dietterich, A. K. Diefenbach (2018), *Assessing Lava Flow Dynamics and Rheology using sUAS Data,* Abstract V43J-0262, AGU Fall Meeting, Washington, DC, 10-14 Dec.

14) **Carr, B. B.**, E. Lev (2018), *Multiple Causes of Dome Collapse During the Prolonged Effusive Eruption of Sinabung Volcano, Indonesia,* Abstract S01.10-399, IAVCEI Cities on Volcanoes 10, Naples, Italy, 3-7 Sept.

13) **Carr, B. B.**, A. B. Clarke, J R. Arrowsmith, L. Vanderkluysen, E. Lev (2018), *Investigating the Emplacement and Collapse of Higher Viscosity Lava with Structure-from-Motion Photogrammetry,* Virtual Geoscience Conference, Kingston, Ontario, Canada, 22-24 Aug.

12) **Carr, B. B.**, R. G. Vaughan (2017), *Utilizing Structure-from-Motion Photogrammetry with Airborne Visual and Thermal Images to Monitor Thermal Areas in Yellowstone National Park,* Abstract NH31A-0203, AGU Fall Meeting, New Orleans, LA, 11-15 Dec.

11) **Carr, B. B.**, A. B. Clarke, L. Vanderkluysen, M. de' Michieli Vitturi (2017), *Earthquake induced variations in extrusion rate: a numerical modeling approach to the 2006 eruption of Merapi Volcano (Indonesia),* Abstract ME43D-055, Scientific Assembly 2017, IAVCEI, Portland, OR, 14-18 Aug.

10) **Carr, B. B.**, A. B. Clarke, J R. Arrowsmith, L. Vanderkluysen (2015), *The Ongoing Lava Flow Eruption of Sinabung Volcano (Sinabung, Indonesia): Observations from Structure-from-Motion and Satellite Remote Sensing,* Abstract V13D-04, AGU Fall Meeting, San Francisco, CA, 14-18 Dec.

9) **Carr, B. B.**, L. Vanderkluysen, A. B. Clarke, J R. Arrowsmith (2014), *The 2013-2014 Effusive Eruption of Sinabung Volcano, Sumatra, Indonesia: Satellite Thermal Observations and Ground-Based Photogrammetry of a Growing Lava Flow,* Abstract V13C-4788, AGU Fall Meeting, San Francisco, CA, 15-19 Dec.

8) **Carr, B. B.**, A. B. Clarke, L. Vanderkluysen (2014), *Identification of Detailed Eruptive Activity Using MODIS TIR images of Merapi Volcano, Java, Indonesia,* Abstract cov8-abs-370, IAVCEI Cities on

Volcanoes 8, Yogyakarta, Indonesia, 9-13 Sept.

7) **Carr, B. B.**, M. de' Michieli Vitturi, A. B. Clarke, B. Voight (2013), *Effects of magma and conduit conditions on transitions between effusive and explosive activity: a numerical modeling approach,* Abstract V23C-2844, AGU Fall Meeting, San Francisco, CA, 9-13 Dec.

6) **Carr, B. B.**, A. B. Clarke, L. Vanderkluysen (2013), *Identification of long- and short-term eruptive trends using satellite TIR records of Merapi Volcano, Java, Indonesia,* Abstract 4W 2E-P16, Scientific Assembly 2013, IAVCEI, Kagoshima, Japan, 20-24 July.

5) **Carr, B. B.**, M. de' Michieli Vitturi, A. B. Clarke, B. Voight (2013), *Effects of magma and conduit conditions on transitions between effusive and explosive activity: A numerical modeling approach to illuminate the 2006-2010 activity at Merapi Volcano, Indonesia,* Abstract 4W 2J-P3, Scientific Assembly 2013, IAVCEI, Kagoshima, Japan, 20-24 July.

4) **Carr, B. B.**, A. B. Clarke, L. Vanderkluysen, M. de' Michieli Vitturi (2012), *Transitions in eruption style at Merapi Volcano (Java, Indonesia); insights from satellite thermal infrared images and numerical modeling,* Abstract V33A-2835, AGU Fall Meeting, San Francisco, CA, 3-7 Dec.

3) Ali, T., K. L. Feigl, T. Masterlark, **B. B. Carr**, F. Sigmundsson, C. H. Thurber (2009), *Geodetic Measurements and Numerical Models of Rifting in Northern Iceland for 1993-1999*, Abstract G41A-0709, AGU Fall Meeting, San Francisco, CA, 14-18 Dec.

2) Graham, S., H. L. Turner, G. S. Mattioli, P. E. Jansma, R. H. Styron, M. J. Burch, **B. B. Carr**, K. Fitzgerald, C. Mansfield (2007), *GPS geodetic constraints on the November 21, 2004 Mw 6.3 earthquake off the northwest coast of Dominica: implications for in situ volatile solubilities and eruption dynamics,* Abstract G43B-12, AGU Joint Assembly, Acapulco, Mexico, 22-25 May.

1) **Carr, B. B.**, G. S. Mattioli, P. E. Jansma, H. L. Turner, R. H. Styron, M. J. Burch, C. Mansfield, S. E. Graham, K. Fitzgerald (2006), *Ongoing Surface Deformation Studies of Dominica, BWI: GPS Results and Interpretations from the 2006 NSF-REU Campaign*, AGU Abstract G53A-0867, AGU Fall Meeting, San Francisco, CA, 11-15 Dec.

## REFERENCES

Dr. Christopher Hamilton
chamilton@arizona.edu (301) 305-3818
Lunar and Planetary Laboratory, University of Arizona
1629 E. University Blvd, Tucson, AZ 85721

Dr. Matt Patrick
mpatrick@usgs.gov (808) 967-8861
Hawaiian Volcano Observatory, United States Geological Survey
1266 Kamehameha Ave, Suite A8, Hilo, HI 96720

Dr. Hannah Dietterich
hdietterich@usgs.gov (907) 786-7474
Alaska Volcano Observatory, United States Geological Survey
4230 University Drive, Anchorage, AK 99508

Dr. Einat Lev
einatlev@ldeo.columbia.edu (845) 365-8616

Lamont-Doherty Earth Observatory, Columbia University
61 Route 9W – PO Box 1000, Palisades, NY 10964

Dr. Amanda Clarke
amanda.clarke@asu.edu (480) 965-6590
School of Earth and Space Exploration, Arizona State University
PO Box 876004, Tempe, AZ 85287

Dr. Loÿc Vanderkluysen
loyc@drexel.edu (215) 571-4673
3245 Chestnut St., PISB 123
School of Biodiversity, Earth, and Environmental Science, Drexel University
3245 Chestnut St., PISB 12, Philadelphia, PA 19104

Dr. R Greg Vaughan
gvaughan@usgs.gov
USGS Astrogeology Science Center
2255 N. Gemini Drive, Flagstaff, AZ 86001