

# CURRICULUM VITAE

## Tom Shea

Dept. of Earth Sciences  
1680 East-west rd. POST 812  
University of Hawaii  
Honolulu, HI, 96822, USA

Ph. : +1 808 956 9819

Fax : +1 808 956 5512

[tshea@hawaii.edu](mailto:tshea@hawaii.edu)

<http://www.soest.hawaii.edu/GG/FACULTY/tshea/index.html>

## Research Interests and activities since 2018

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I broadly investigate volcanoes and volcanic processes. Much of my research is focused around the study of products from both explosive and effusive volcanism. I use field, laboratory, experimental and analytical techniques to link volcanic deposits to magma storage, ascent, fragmentation, and ash transport, in order to understand the behavioral patterns and timescales of volcanic phenomena.

## Education

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2010: PhD – Geology and Geophysics, University of Hawaii at Mānoa, USA. Subject: the AD79 eruption of Vesuvius, Italy.

2006: MSc – Earth Sciences, Université Blaise Pascal, Clermont-Ferrand, France. Subject: Analogue modeling of rockslide avalanches.

2005: MSc – Natural Hazard Mitigation, Universidad Autónoma de Barcelona, Barcelona, Spain. Subject: Mitigation of landslide hazards around Central American volcanoes.

2003: BA – Earth Sciences, Université Blaise Pascal, Clermont-Ferrand, France. Subject: monazite dating of eclogitic host rocks from Vendée, France.

## Professional experience

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2018-present: Assistant Professor - University of Hawaii at Mānoa, USA

2010-2018: Assistant Researcher - University of Hawaii at Mānoa, USA

## Extramural support (active grants in bold)

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### *Funded as PI:*

**[1]** National Science Foundation EAR Grant ‘Analyses of volatiles in volcanic glasses: bridging the gap between the macroscopic and the micron scale’ (PI, \$191,591), 2013-2016.

**[2]** National Science Foundation EAR Grant ‘Pursuing the nucleus: experimental, theoretical, and analytical investigations of bubble and crystal formation in magma’ (PI, \$266,200), 2013-2016.

**[3]** National Science Foundation EAR Program ‘Experimental Investigation of Chemical Zoning in Olivine: Applications to Hawaiian Basalt.’ (PI, \$346,000), **2017-2020**.

### *Pending as PI:*

**[1]** National Science Foundation EAR Grant ‘Collaborative Research: Size, depth and longevity of magma reservoirs under Kilauea's rift zones: Integrating melt inclusion data and thermal modeling’ (PI, \$331,571), 2020-2023.

*Funded as co-PI:*

[4] NASA Solar System Workings Grant 'Exploring the Time-Temperature Characterization of Troctolite 76535.' (co-PI, \$426,388), **2016-2020**. PI: Julia Hammer.

[5] NSF EAR Program 'Advances in crystal growth: Experimental and microscopic study of olivine phosphorus zoning' (co-PI, \$395,566), **2017-2020**. PI: Benoit Welsch.

[6] NSF RAPID Program 'Tracking magmatic and volcanic changes in the May 2018 Kilauea Eruption' (co-PI, \$119,821), **2018-2020**. PI: Ken Rubin

[7] NSF EAR Program 'Collaborative Research: Elucidating the Role of Titanomagnetite in Vesiculation of Silicic Magmas' (co-PI, \$373,112), **2019-2022**. PI: Julia Hammer

### **Awards and Honors**

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- Geological Society of America Mineralogy-Geochemistry-Petrology-Volcanology (MGPV) Early Career Award in 2017
- ARCS Graduate Student Award 2009 (\$5,000)
- IAVCEI conference travel grants from NSF (\$1,600) and IAVCEI organization (\$1,000)
- Graduate Student Organization travel grant, August of 2007 for field work in Italy (\$600).
- CROUS French University Excellence scholarship awarded in 2005-2006 for MSc degree (\$5,000)
- CentralRisk European scholarship awarded in 2004-2005 for first MSc degree (\$10,000)

### **Teaching**

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Spring 2019, 2020, Igneous & Metamorphic Petrology (ERTH-302), 3 cr., lectures/labs, *UH Mānoa*

Fall 2017, 2019 Lava flow rheology and morphology (GG-605), 3 credits, lectures, *UH Mānoa*

Fall 2016, Geospatial Information (GG-461), 3 credits, lectures and labs, *UH Mānoa*

Guest Lectures, Spring 2016, Igneous and Metamorphic Petrology GG 302, 2 lectures, *UH*

Guest Lectures, Spring 2014, Diffusion modeling shortcourse, 4 units over 2 weeks, *UH*

Invited Lecturer, Spring 2013, Volcanology Graduate course, 4 units over 4 weeks, *Université Blaise Pascal, Clermont-Ferrand, France*

Teaching Assistant, Mineralogy (301), Fall 2009 with Julia Hammer, *UH*

Teaching Assistant, Intro to geology (101), Fall 2009 with Scott Rowland, *UH*

Teaching Assistant, Mineralogy (301), Fall 2008 with John Sinton, *UH*

### **Students mentored in advisory or co-advisory role**

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Rebecca deGraffenried (PhD, current), Adrien Mourey (PhD, current), Kelly McCartney (PhD current), Tanis Leonhardi (BSc, 2015), Charline Lormand (MSc, 2015), Mathieu Colombier (MSc, 2013), Natalie Yakos (BSc, 2008).

### **Graduate student committees (UH Mānoa)**

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Jonathan Tree (MSc), Emily First (PhD), Kendra Lynn (PhD), Sam Mitchell (PhD), Samantha Isgett (PhD), Rebecca deGraffenried (PhD), Adrien Mourey (PhD), William Nelson (MSc), Olliander Beucler (MSc), Malia Zinn (MSc)

## Student comprehensive exam committees (UH Mānoa)

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Sam Mitchell (PhD), Thomas Giguere (PhD), Rebecca deGraffenried (PhD), Lauren Ward (PhD), Adrien Mourey (PhD)

## Journal articles published

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[31] Lynn KJ, Garcia MO, **Shea T**, Phosphorous obfuscates lithium geospeedometry in olivine. *Frontiers in Earth Science*, In press.

[30] Costa F, **Shea T**, Ubide T (2020) Diffusion chronometry and the timescales of magmatic processes. *Nature Reviews – Earth and the Environment*. In press. doi : 10.1038/s43017-020-0038-x

[29] Gansecki C, Lee RL, **Shea T**, Lundblad S, Hon K, Parcheta C (2019) The tangled tale of Kīlauea's 2018 eruption as told by geochemical monitoring. *Science*, 366. 10.1126/science.aaz0147.

[28] Mourey AJ, **Shea T** (2019) Forming olivine phenocrysts in basalt: a 3D characterization of growth rates in laboratory experiments. *Frontiers in Earth Sciences*, 7 doi: 10.3389/feart.2019.00300 .

[27] Giachetti T, Hudak MR, **Shea T**, Bindeman I, Hoxsie EC (2019) D/H ratios and H<sub>2</sub>O contents record degassing and rehydration history of rhyolitic magma and pyroclasts. *Earth and Planetary Science Letters*. doi: 10.1016/j.epsl.2019.115909

[26] **Shea T**, Hammer JE, Hellebrand E, Mourey A, Costa F, First E, Lynn KJ, Melnik O, (2019) Phosphorus and aluminum zoning in olivine: contrasting behavior of two nominally incompatible elements. *Contributions to Mineralogy and Petrology*. 174:85.

[25] Owen J, **Shea T**, Tuffen H, (2019) Basalt, Unveiling Fluid-filled Fractures, Inducing Sediment Intra-void Transport, Ephemeral: examples from Katla 1918. *Journal of Volcanology and Geothermal Research*. 369:121-144.

[24] Lynn KJ, **Shea T**, Garcia MO, Costa F, Norman MD (2018) Lithium diffusion in olivine records priming of explosive basaltic eruptions, *Earth and Planetary Science Letters*, 500:127-135.

[23] Mitchell SJ, McIntosh IM, Houghton BF, Carey RJ, **Shea T** (2018) Dynamics of a powerful deep submarine eruption recorded in H<sub>2</sub>O contents and speciation in rhyolitic glass: The 2012 Havre eruption, *Earth and Planetary Science Letters*, 494:135:147.

[22] Lynn KJ, Garcia MO, **Shea T**, Costa F, Swanson DA (2017) Timescales of mixing and storage for Keanakako'i Tephra magmas (1500-1820 C.E.), Kilauea Volcano, Hawai'i, *Contributions to Mineralogy and Petrology*. 172:76.

[21] **Shea T** (2017) Bubble nucleation in magmas: a dominantly heterogeneous process? *Journal of Volcanology and Geothermal Research*. 343:155-170.

[20] **Shea T**, Leonhardi T, Giachetti T, Larsen J, Lindoo A, Sinton, J, Parson E, (2017) Dynamics of an unusual cone-building trachyte eruption at Pu'u Wa'awa'a, Hualālai, Hawaii, *Bulletin of Volcanology*. 79:2.

[19] Colombier M, Gurioli L, Druitt TH, **Shea T**, Boivin P, Miallier D, (2017) Textural evolution of magma during the 9.4 ka trachytic explosive eruption at Kilian Volcano, Chaîne des Puys, France, 2015, *Bulletin of Volcanology*. 79:17.

[18] Lynn KJ, **Shea T**, Garcia MO, (2017) Nickel variability in Hawaiian olivine: Evaluating the relative contributions from mantle and crustal processes, online first, *American Mineralogist*. DOI 10.2138/am-2017-5763.

- [17] Graham DW, Michael PJ, **Shea T, (2016)** Extreme Incompatibility of Helium During Mantle Melting: Evidence from Undegassed Mid-Ocean Ridge Basalts. *Earth and Planetary Science Letters*. 454:192-202.
- [16] **Shea T**, Owen J., (2016) Discovery of a trachyte ignimbrite sequence at Hualalaī, Hawaii, *Bulletin of Volcanology*. 78, 34.
- [15] **Shea T**, Lynn, K.J., Garcia, M.O., (2015) Cracking the olivine zoning code: Distinguishing between crystal growth and diffusion, *Geology*, 43:935-938.
- [14] **Shea T**, Costa, F., Krimer D., Hammer J.E, (2015) Accuracy and precision of timescales retrieved from diffusion modeling in olivine: a 3D perspective, *American Mineralogist*, 100:2026-2042.
- [13] Giachetti T, Gonnermann H, Gardner, J, **Shea T**, Gouldstone A (2015) Discriminating secondary from magmatic water in rhyolitic matrix-glass of volcanic pyroclasts using thermogravimetric analysis. *Geochimica and Cosmochimica Acta*, 148:457-476.
- [12] **Shea T**, Gurioli L, Hellebrand E, Tuffen, H (2014) Conduit to localized scale degassing during Plinian eruptions: insights from major element and volatile (Cl and H<sub>2</sub>O) analyses within AD79 Vesuvius pumice. *Journal of Petrology*, 55:315-344.
- [11] **Shea T**, Hammer JE, First E (2013) Pumice balloons or bombs? *Nature Geoscience (Corresp.)*, 6:802-803.
- [10] **Shea T**, Hammer JE (2013) Rates of oxidation in CSPV experiments involving H<sub>2</sub>O-bearing mafic magmas. *American Mineralogist*, 98:1285-1296.
- [9] **Shea T**, Hammer JE (2013) Kinetics of cooling- and decompression-induced crystallization in hydrous mafic-intermediate magma. *Journal of Volcanology and Geothermal Research*, 260:127-145.
- [8] **Shea T**, Gurioli L, Houghton, BF (2012) Transitions between fall phases and pyroclastic density currents during the AD 79 eruption at Vesuvius: building a transient conduit model from the textural and volatile record. *Bulletin of Volcanology*, 74:2363-2381.
- [7] **Shea T**, Gurioli L, Houghton, BF, Cioni, R, Cashman KV (2011) Column collapse and generation of pyroclastic density currents during the AD 79 eruption of Vesuvius: the role of pyroclast density. *Geology*, 39, 695-698.
- [6] **Shea T**, Houghton BF, Gurioli L, Cashman KV, Hammer JE, Hobden B (2010) Textural investigations of vesicles in volcanic rocks : an integrated methodology. *Journal of Volcanology and Geothermal Research*, 190, 271-289.
- [5] **Shea T**, v. Wyk de Vries (2010) Collapsing volcanoes: the sleeping giants' threat. *Geology Today*, 26, 2, 72-77.
- [4] **Shea T**, Gurioli L, Larsen JF, Houghton BF (2010) Linking experimental and natural vesicle textures in Vesuvius 79AD white pumice. *Journal of Volcanology and Geothermal Research*, 192, 69-84.
- [3] **Shea T**, Larsen JF, Gurioli L, Houghton BF, Hammer JE, (2009), Leucite crystals : surviving witnesses of magma storage conditions prior to the 79AD eruption at Vesuvius, Italy. *Earth and Planetary Science Letters*, 281, 88-98.
- [2] **Shea T**, van Wyk de Vries B, Pilato M, (2008), Emplacement mechanisms of contrasting debris avalanches at Volcan Mombacho (Nicaragua), provided by structural and facies analysis. *Bulletin of Volcanology*, 70, 899-921.

[1] **Shea T**, van wyk de Vries, (2008), Structural analysis and analogue modelling of the kinematics and dynamics of large-scale rockslide-avalanches. *Geosphere*, 4, 657-686.

### **Articles under review/in preparation**

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[i] Gordeychik, B, Churikova T, **Shea T**, Kronz A, Simakin A, Worner G, Fo and Ni relations in olivine differentiate between crystallization and diffusion trends. In revision, *Journal of Petrology*.

[ii] Colombier M, **Shea T**, Burgisser A, Druitt TH, Gurioli L, Müller D; Cáceres F, Hess K-U, Dingwell DB, Rheological change and degassing during a trachytic Vulcanian eruption at Kilian volcano, Chaîne des Puys, France. In review, *Bulletin of Volcanology*.

[iii] **Shea T**, Giachetti T, Gonnermann H, Donnelly-Nolan J, Hybrid volcanism during the AD1100 Big Glass Mountain eruption at Medicine Lake (California): lessons from pyroclastic obsidian. To be submitted to *Bulletin of Volcanology*.

[iv] **Shea T**, Ishii H, Bradley J, Ohtaki K, Strain-Testing Diffusion Modeling in the Lab: Zeroing in on the Reactive Crystal-Melt Interface. In prep., *Frontiers in Earth Science*.

### **Service**

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- Co-organizer since 2019 of CONVERSE (Community Network for Volcanic Eruption Response <https://volcanoresponse.org/>), on the Petrology and Geochemistry working group. Objective: organize the community for coordinated response to volcanic eruptions in the US (NSF-supported RCN project)
- Invited lecturer & participant for the CIDER Workshop in Berkeley (2 weeks, June 2019) (<https://www.deep-earth.org/summer19>)
- Associate editor, *American Mineralogist*, special collection "Volcanic Rocks" (2013-2016)
- Organizer and leader of GSA Cordilleran Section 2017 field trip on Kilauea volcano (2 days)
- Co-Chair of sessions at international conference AGU 2007, 2012, 2013, 2019
- Co-Chair of session at Goldschmidt 2014, 2019 conference
- Co-Chair of session at IAVCEI 2017 conference, Portland
- EARTH Department committees (2)
- Proposal reviews, *National Science Foundation* 'EAR', 'GeoPRISMS', and 'Career' programs (14)
- Manuscript Reviews for international journals, 2009-2019 (>40): *Earth and Planetary Science Letters* (1), *G-cubed* (1), *Earth Surface Processes and Landforms* (2), *Journal of Volcanology and Geothermal Research* (6), *Geochimica and Cosmochimica Acta* (1), *Solid Earth* (1), *Bulletin of Volcanology* (8), *Journal of Petrology* (1), *Marine Geology* (1), *Computers and Geosciences* (1), *Journal of Asian Earth Sciences* (1), *Lithos* (1), *Geosphere* (1), *Nature Geoscience* (2), *Contributions to Mineralogy and Petrology* (2), *Geology* (1), *Journal of Geophysical Research* (1).
- Development and distribution of computer programs FOAMS (Fast Object Analysis and Measurement System) since 2009 to facilitate textural investigations in volcanology <http://www.soest.hawaii.edu/GG/FACULTY/tshea/foams/index.html>.
- Development and distribution of SpeCTRA (Spectrum Correction Tools for Raman) to facilitate analysis of H<sub>2</sub>O in glass via microRaman spectroscopy since 2016. Distributed on the personal website <http://www.soest.hawaii.edu/GG/FACULTY/tshea/spectra/spectra.html>.
- Organizer of Volcanology-Geochemistry-Petrology discussion seminars at Univ. Hawaii 2010-2015.
- Co-exhibitor at School of Ocean and Earth Science and Technologies (SOEST) Open House 2007, 2009, 2013 and 2015 (Explosive Volcanism, Electron Microprobe). Introduction to fine scale rock analysis using EPMA. Demonstrations of volcanic explosions using dry ice, and liquid nitrogen.

## Community/Outreach

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- Oahu Public Library STEM program (3): “The 2018 Kilauea eruption”. 1hr presentations followed by hands on activities.
- Development of information pamphlets aimed at the general public about geological features (e.g. the Pu’u Wa’awa’a cone on the island of Hawaii, currently distributed at the location trail head, and available for pdf download at <http://www.soest.hawaii.edu/GG/FACULTY/tshea/outreach.html>).
- Featured scientist in a Hawaii television series “Voice of the Sea” about researchers investigating natural processes around the Hawaiian Islands, Sept. 2012, aired 2014 (US).
- Scientific consultant for BBC animated series “Factomania”, featuring one episode on volcanoes and volcanologists, Sept. 2013, aired 2014 (UK).
- Participation in book “Elemental Journeys” (Ken Glaser, ISBN-1450794289, 2012), on the career callings of an earth scientist specializing in the study of volcanoes.
- Featured volcanologist in 110-min prime-time French documentary “Living Earth” for a section on the modern understanding of Hawaiian volcanism, Nov. 2013, aired 2014 (France).

## Analytical experience

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Electron Microprobe Analysis (EMPA, instrument calibration, maintenance, troubleshooting)

Scanning Electron Microscope (Imaging, Energy-Dispersive X-ray Spectroscopy EDS, Electron Backscatter Diffraction EBSD).

Raman Spectroscopy (analysis of minerals and glasses, quantification of glass H<sub>2</sub>O concentrations).

Fourier Transform Infrared spectroscopy FTIR (H<sub>2</sub>O-CO<sub>2</sub> in glasses).

He-pycnometry, permeametry (porosity-connectivity of vesicles in pyroclasts).

## Laboratory experience

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### *Experimental petrology:*

Horizontal and vertical furnaces using cold-seal pressure vessels (“CSPV”, Rene-Waspaloy®) for cooling, decompression and phase equilibria experiments.

High-temperature furnaces (TZM and MHC cold-seal pressure vessels)

1-atm gas mixing furnace for cooling and phase equilibria experiments (up to ~1600°C)

Vernadsky 1-atm rapid quench Heating stage (up to ~1600°C) (**set up in 2019**)

Thin section and polished wafer preparation

### *Physical volcanology:*

Grain-size analysis, componentry

Density/vesicularity (construction and operation of Archimedes-based setup)

Permeability (construction and operation of permeameter)

### *Analogue modeling:*

Debris avalanche/rockslide scaled models (ramps, granular media, scaled volcanic edifices)

Volcano-spreading scale models (immobile and dynamic surfaces, silicon putty, granular media)

Magmatic intrusions (golden syrup, granular and cohesive media)

## Computer and programming experience

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### *Programming languages:*

Matlab (Advanced), Python (Basic), R (Basic)

*Design and scientific programs:*

ArcGIS (GIS software), Probe for EPMA (electron microprobe), FLIR Software (thermal analysis of IR imagery), Shape (3D crystal morphology), PhotoScan (Structure from Motion, Photogrammetry), AutoCAD Inventor (3D design), Bruker Opus (FTIR software), WiteC Control (Raman software).

**Collaborations (active)**

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Costa, Fidel (*Earth Observatory Singapore*)  
Couperthwaite, Fiona (*University of Leeds*)  
Donnelly-Nolan, Julie (*USGS*)  
Gansecki, Cheryl (*University of Hawaii*)  
Giachetti, Thomas (*University of Oregon*)  
Gonnermann, Helge (*Rice University*)  
Graham, David (*Oregon State Univ.*)  
Gordeychik, Boris (*Moscow Uni.*)  
Gurioli, Lucia (*Université Blaise Pascal*)  
Hammer, Julia (*University of Hawaii*)  
Hellebrand, Eric (*University of Utrecht*)

Larsen, Jessica (*Univ. of Alaska Fairbanks*)  
Lee, Lopaka (*USGS*)  
Lynn, Kendra (*University of Delaware*)  
Mitchell, Sam (*University of Hawaii*)  
Owen, Jacqui (*Lancaster University*)  
Ramsey, David (*USGS*)  
Shiro Brian (*USGS*)  
Tuffen, Hugh (*Lancaster University*)  
Ustunisik, Gokce (*South Dakota Sch. of Mines*)

**Miscellaneous**

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Citizenships: US and French

Languages: Fluent in English, French, Spanish; Advanced in Catalan; Basic German