

Hanna L. Brooks

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EDUCATION:

Doctorate of Science, Geosciences

University of Maine, Orono, ME
January 2019-Present
GPA: 3.93/4.00

Masters of Science, Geosciences

University of Alberta, Edmonton, AB, Canada
August 2017-May 2018
GPA: --/4.00

Masters of Science, Geosciences

University of Arizona, Tucson, AZ
August 2016-July 2017 (Transferred)
GPA: 3.73/4.00

Bachelor of Science, Geosciences

Virginia Polytechnic Institute and State University (Virginia Tech),
Blacksburg, VA
Option: Geology
August 2011-December 2015
GPA: 3.68/4.00
University Honors: Fall 2012-Fall 2015

Field Camp, Geosciences

Idaho State University, Pocatello, ID
May 2015-July 2015
GPA: 4.00/4.00

SKILLS/QUALIFICATIONS:

Certifications

- Laser Safety (University of Maine, 2019-present)
- Annual Laboratory Safety (University of Maine, 2019-present)
- Analytical X-Ray Equipment (Virginia Tech, 2013-2016)

Equipment

- Can operate and interpret results from: LA-ICP-MS/MS, Raman, X-ray diffractometer, and Microprobe
- Proficient with Diamond Saw, Rock Crusher, Powdering Mill, Grinder/Polisher
- Proficient with using a petrographic and fluid inclusion microscope and fluid inclusion microthermometry heating/cooling stages

Software/Computer Skills

- Proficient on OSX, Windows, Linux
- Adobe Systems
- ArcMap
- IsoplotR
- Ziess Zen Pro
- Proficient with: VBA
- Microsoft Office Suite
- Perple_X
- ERDAS Imagine
- Iolite
- Familiar with: C++, HTML, R

GRADUATE COURSE WORK:

- Introduction to Geochemistry
- Fluids of the Earth
- Mineral Resource Estimation
- Isotope Geology
- Introduction to Circuits
- Geodynamics
- Remote Sensing of Earth
- Regional Structural Geology
- Isotope Geochemistry
- Rheology
- Marine Geology

UNDERGRADUATE ELECTIVE COURSE WORK:

- Earthquake Seismology
- Environmental Geochemistry
- Advanced Structural Geology
- Exploration Seismology
- Geochemical Thermodynamics
- Fluid Inclusions Techniques

RESEARCH INTERESTS:

My initial research interests have been focused in migration and properties of fluids in the Earth. Compositions and migration of Earth fluids have profound implications for understanding geologic systems. Many processes vital to the planet are initiated and driven by fluid-rock interactions. Study of these fluids provides vital insight into the workings of the planet.

Recently, I have become interested in inductively coupled mass spectrometry (ICP-MS) and the potential this method has assist in answering many outstanding geologic questions. My work is focused on the precise identification, dating, and characterization of past geologic and anthropogenic events in crustal rocks and ice cores. In crustal rocks, I am interested in developing and improving geologic based methods applied to radiogenic dating series. Advancements in the last few years now allows for in-line chemistry to occur within a reaction cell, permitting the elimination of isotopic interferences *in-situ* and precise dating of beta decay chain methods (i.e. Rb-Sr) in environments previously impossible without difficult wet chemistry. Using ice cores from Mt. Hunter, I am examining the historical record of pollution (particularly lead) through time from both Asian and North American sources.

RESEARCH EXPERIENCE:

Tracing of Pollution through Time in the North Pacific; PhD Project

Department Earth and Climate Sciences & Climate Change Institute, University of Maine, Orono, ME
May 2020-Present

Research Advisor: Karl Kreutz

- Examining pollution (i.e. lead) records through time as recorded in the Mt. Hunter, Alaska ice cores
- Trace elements, lead isotopes, and chronology data will be collected via ICP-MS and LA-ICP-MS methods

Development of Rb/Sr LA-ICP-MS/MS Methods for Geology; PhD Project

Department Earth and Climate Sciences, University of Maine, Orono, ME
January 2019-Present

Research Advisor: Alicia Cruz-Urbe

- Developing new methodology for Rb-Sr dating and analysis of Sr-Sr
- Examining a suite of reference materials and unknowns to thoroughly test methodology to ancient and modern with applications to environmental determination
- Examination of MicaMg and MicaFe as useful reference materials for mica dating, particular focus to date mica from the Norumbega Fault Zone.

LA-ICP-MS/MS Projects in the MicroAnalytical Geochemistry and Isotope Characterization (MAGIC) Laboratory; Lab Manager during PhD

Department Earth and Climate Sciences, University of Maine, Orono, ME

January 2019-July 2020

Research Advisor: Alicia Cruz-Uribe

- Providing training to secondary daily users of the lab facilities and ensuring proper standard operating procedures are in place and followed
- Aiding in sample preparation, data collection, and data reduction for a wide spectrum of projects including: Foraminifera, Otoliths, Bivalve shells, Garnets and other silicates, U-Pb dating of accessory minerals, and Sulfur

Development of U-Pb LA-ICP-MS/MS Methods for Geology

Department Earth and Climate Sciences, University of Maine, Orono, ME

January 2019-May 2020

Research Advisor: Alicia Cruz-Uribe

Undergraduate Researcher: Joshua Stone

- Developing new methodology for U-Pb dating of accessory minerals, primarily apatite and titanite, using in-line reactions to remove interferences
- Examining a suite of reference materials and unknowns to thoroughly test methodology

Mineral Solubility in H₂O-salt Systems; Primary Masters Project

Department of Geosciences, University of Arizona, Tucson, AZ

Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, AB, Canada

August 2016-May 2018

Research Advisor: Matthew Steele-MacInnis

- Studying solubility of minerals in aqueous fluids (H₂O and brines) in order to develop a large-scale model for solubility
- Developing a new computer code to quickly calculate fluid properties and to determine mineral solubility for a wide range of *P-T-x* space

Extensional Exhumation of the Alichur Dome, South Pamir; Collaborative Project

Department of Geosciences, University of Arizona, Tucson, AZ

Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, AB, Canada

Geologie, TU Bergakademie Freiberg, Freiberg, Germany

May 2017 - Present

Main Collaborator: James Worthington

- Contributing fluid inclusion analysis to an ongoing structural analysis of the Alichur Dome in order to gain additional clarity regarding the system - including fluid trapping conditions and chemistry

Fluids in the Catalina-Rincon Metamorphic Core Complex; Collaborative Project

Department of Geosciences, University of Arizona, Tucson, AZ

Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, AB, Canada

January 2017-Present

Project Collaborators: Tanner Grouse, George Davis, Matthew Steele-MacInnis

- Examining how footwall rock mineral crystallization changes along the normal fault of the Catalina-Rincon metamorphic core complex to create a link between the fluid and structural histories of the rocks
- Studying fluid movement, chemistry, and trapping conditions along the fault

Fluid Chemistry in the Hellenic Subduction Zone; Undergraduate Research

Department of Geosciences, Virginia Tech, Blacksburg, VA

June 2013-Dec 2015

Research Advisor: Mark Caddick

- Worked with Boston University to study subduction zone metamorphism on the Aegean Islands of Syros and Sifnos
- Used fluid inclusion data and thermodynamic modeling of major phase stability to provide a complete understanding of the P - T - t history of the system
- Completed an undergraduate thesis detailing the methodology and findings of the study

FIELD EXPERIENCE:

Regional Structural Geology/Mapping Practicum

University of Arizona, Tucson, Arizona

Spring 2017

- Independent geologic mapping of the rock units comprising the Catalina-Rincon metamorphic core complex, including detailed geologic cross sections and sampling/analysis of rock units
- Completed detailed rock descriptions, unit descriptions, and structural analysis of faults and folds

Lowell Program in Economic Geology Short Course on Porphyry Cu, Mo, and Au

Department of Geosciences, University of Arizona, Tucson, AZ

December 6-15, 2016

- Week long short course examining the terminology/classification, creation, discovery, and mining of porphyry deposits, including labs examining hand samples and fieldtrips to active and inactive mine sites throughout Arizona

Geology Field Camp

Idaho State University, Mackay, Idaho

Summer 2015

- Independent field mapping of sedimentary, igneous, and metamorphic rocks in central Idaho including Precambrian gneiss, Phanerozoic sedimentary rocks, Eocene zoned plutons, intermediate and bimodal volcanic rocks, Pleistocene-Holocene fluvial and glacial geomorphology along an active normal fault
- Completed detailed rock and unit descriptions, and structural analysis of faults and folds
- Submitted numerous complete geologic maps and reports, both digital and hand-drafted, concerning geologic processes and histories

Hellenic Subduction Zone Field Work, Undergraduate Research

Virginia Tech, Syros, Greece

Summer 2014

- Selected sampling locations for the purpose of enhancing understanding of subduction zone processes, particularly the timing and release of fluids
- Collected samples and extensive field notes primarily on exhumed units on the island

LAB & TEACHING EXPERIENCE:

Lab Manager, MAGIC Lab (MicroAnalytical Geochemistry and Isotope Characterization Laboratory), University of Maine, Spring 2019 - July 2020

Introduction to Geology, University of Maine, Fall 2020

Planet Earth, University of Alberta, Fall 2017

Oceanography, University of Arizona, Fall 2016

AWARDS:

Graduate Student Government Travel-to-Present Grant: Spring 2020; Spring 2019
Graduate Students' Association Academic Travel Award: September 2017
Geological Society of America Travel Grant: September 2017
Economic Geology Scholarship, University of Arizona: Fall 2016
Dean's List, Virginia Tech: Fall 2011-Fall 2015
David and Ruth Henderson Scholarship, Virginia Tech: Fall 2014-Fall 2015
Virginia Tech Department of Geosciences Undergraduate Service Award: Spring 2014
The Edith L. & Lawrence E. Meade, Sr., Geological Sciences Scholarship: Spring 2013, Fall 2013
Girl Scout Gold Award: March 2011

SHORT COURSES:

Cruz-Uribe, A.M. & BROOKS, H. L., 2019. Innovations in LA-ICP-MS in the Earth Sciences. In: *54th Annual Meeting of GSA's Northeastern Section*, Portland, ME, March 16, Ran Short Course

PUBLICATIONS:

Worthington, J. R., Ratschbacher, L., Stübner, K., Kapp, P., Chapman, J. B., Rutte, D., Khan, J., Stevens, A., Jonckheere, R., Pfänder, J., Oimahmadov, I., Gadoev, M., BROOKS, H. L., Lamadrid, H. M., & Steele-MacInnis, M., 2019. The Alichur Dome, South Pamir, Western India-Asia Collisional Zone: Detailing the Neogene Shakhdara-Alichur Syn-collisional Gneiss-Dome Complex and Connection to Lithospheric Processes. *Tectonics*. doi:10.1029/2019TC005735

BROOKS, H. L. & Steele-MacInnis, M., 2019. Modeling mineral solubility in water-salt systems from the crust to upper mantle. *American Journal of Science*, 319, 754-787. doi:10.2475/09.2019.02

BROOKS, H. L., Dragovic, B., Lamadrid, H. M, Caddick, M. J., & Bodnar, R. J., 2019. Fluid capture during exhumation of subducted lithologies: A fluid inclusion study from Sifnos, Greece. *Lithos*, 332-333, 120-134. doi:10.1016/j.lithos.2019.01.014

BROOKS, H. L., 2018. *A Model for the Solubility of Minerals in Saline Aqueous Fluids in the Crust and Upper Mantle*, University of Alberta, Edmonton, Alberta (Master's Thesis).

BROOKS, H. L., 2015. *A Complex History of Fluid-Rock Interaction during Subduction and Exhumation of Blueschists*, Virginia Tech, Blacksburg, VA (Undergraduate Honors Thesis).

CONFERENCES:

Stone, J.S., Cruz-Uribe, A.M., BROOKS, H.L., & Walters, J., 2019. U-Pb dating of accessory minerals by LA-ICP-MS/MS. In: *100th American Geophysical Union (AGU) Fall Meeting*, San Francisco, California, Dec 9- 13, Poster.

Stripe, C., Allen, K., Stikes, E., Zhou, X., Rosenthal, Y., Cruz-Uribe, A.M., & BROOKS, H.L., 2019. Assessing the Benthic Mg/Ca-Temperature Proxy: A *Uvigerina* Core-Top Study from New Zealand. In: *100th American Geophysical Union (AGU) Fall Meeting*, San Francisco, California, Dec 9-13, Poster.

BROOKS, H.L., Cruz-Uribe, A.M., & Stone, J.S., 2019. Trace elements in mollusc shells and benthic foraminifera. In: *3rd North American Workshop for Laser Ablation (NAWLA)*, Austin, Texas, May 28-31, Poster.

Stone, J.S., Cruz-Uribe, A.M., & BROOKS, H.L., 2019. U-Pb dating of titanite by LA-ICP-MS. In: *3rd North American Workshop for Laser Ablation (NAWLA)*, Austin, Texas, May 28-31, Poster.

- Steele-MacInnis, M. & BROOKS, H. L., 2019. Solubilities of minerals in saline hydrothermal fluids. In: *25th European Current Research on Fluid Inclusions (ECROFI-XXIII)*, Budapest, Hungary, June 23-29, Keynote
- Dragovic, B., BROOKS, H. L., Lamadrid, H., Caddick, M. J. & Bodnar, R. J., 2018. Fluid Capture During Exhumation of Subducted Lithologies: A Fluid Inclusion Study from the Cycladic Blueschist Unit (Sifnos, Greece). In: *99th American Geophysical Union (AGU) Fall Meeting*, Washington D.C., Dec 10-14, Poster
- BROOKS, H. L. & Steele-MacInnis, M., 2018. A new model for the solubility of common rock-forming minerals in saline aqueous fluids up to 1100 °C and 20 kbar. In: *The Edwin Roedder 14th Pan-American Current Research on Fluid Inclusions (PACROFI-XIV) Conference*, Houston TX, USA, June 11-16. Abstracts with Program, p. 31-32, Talk
- BROOKS, H. L., 2017. Mineral Solubility in Complex Saline Aqueous Fluids at Crustal and Upper Mantle Conditions. In: *ATLAS, Annual Departmental Conference*, University of Alberta, Edmonton, AB, Canada, April, Talk
- BROOKS, H. L., Steele-MacInnis, M., & Lecumberri-Sanchez, P., 2017. An Examination of Mineral Solubility in Complex Saline Aqueous Fluids. In: *GSA Annual Conference*, Seattle, WA, 22-25 Oct, Talk
- BROOKS, H. L. & Steele-MacInnis, M., 2017. Modeling the Solubilities of Minerals in Saline Aqueous Fluids. In: *GeoDaze, Annual Departmental Conference*, University of Arizona, Tucson, AZ, March 30-Apr 1, Talk
- BROOKS, H. L., Lamadrid, H. M., Caddick, M. J., Dragovic, B. & Bodnar, R. J., 2015. Insights into subduction zone fluid chemistries from fluid inclusions in Blueschist from Sifnos, Greece. In: *GSA Annual Meeting*, Baltimore, Nov 1-4, Poster
- Gorce, J. S., Caddick, M. J., Baxter, E. F., Ashley, K. T., Kendall, J. A., BROOKS, H. L. & Ramos, E., 2015. P-T paths from Syros, Greece, and constraints on subduction zone fluid generation. In: *GSA Annual Meeting*, Baltimore, Nov 1-4, Poster
- Kendall, J. A., Baxter, E. F., Caddick, M. J., Gorce, J. S., Ramos, E. & BROOKS, H. L., 2015. Samarium/neodymium garnet geochronology of eclogites from Syros, Greece. In: *GSA Annual Meeting*, Baltimore, Nov 1-4, Poster
- Ramos, E., Baxter, E. F., Caddick, M. J., Kendall, J. A., Gorce, J. S. & BROOKS, H. L., 2015. Thermodynamic analysis of blueschist links garnet growth to progressive subduction zone dehydration in the Cycladic blueschist unit of Syros, Greece. In: *GSA Annual Meeting*, Baltimore, Nov 1-4, Poster
- BROOKS, H. L., & Caddick, M. J., 2015. Insights into Fluid Chemistry in Subduction Zones Using Fluid Inclusions in Blueschist from Sifnos, Greece. In: *Geosciences Student Research Symposium, Annual Departmental Conference*, Virginia Tech, Blacksburg, VA, March, Talk

ACTIVITIES AND MEMBERSHIPS:

- American Geophysical Union (2018-Present)
- Geochemical Society; Member (2017-Present)
- Society of Economic Geologists; Member (2016-Present)
- Geological Society of America; Member (2014-Present)
- American Institute of Professional Geologists; Member (2016-2018)
- Arizona Geological Society; Member (2016-2017)

OTHER EXPERIENCE:

- Volunteer Tour Guide**, University of Alberta Rock and Mineral Museum and Paleontology Museum, University of Alberta, Edmonton, AB; Oct 2017-May 2018
- Geoscientist-in-the-Park Intern**, National Park Service and AmeriCorps, Shenandoah National Park, Luray, VA; May 2017-August 2017
- Volunteer Tour Guide**, Virginia Tech Museum of Geosciences, Virginia Tech, Blacksburg, VA; 2014-2015