

EMMA SOFIA SOSA

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EDUCATION

California Institute of Technology , Pasadena, CA PhD in Geology	2019-2024
California Institute of Technology , Pasadena, CA Master's in Geology	2017-2019
Lafayette College , Easton, PA Bachelor of Science in Geology, Magna Cum Laude	2013-2017

SELECTED AWARDS

Gunilla Hastrup Adventure Award , The Caltech Y Funding used to participate in a summer Spanish immersion program in Costa Rica while living with a Costa Rican host family, including 4+ hours of daily classes and touring national parks.	Fall 2023
Graduate Research Fellowship (GRFP) , National Science Foundation Three-year merit-based award covering Caltech graduate student tuition and research stipend.	Spring 2019
Earle C. Anthony Graduate Fellowship , Caltech One-year merit-based research fellowship given annually to support a minority student entering a graduate program in STEM at Caltech.	Spring 2017
Dwornik Award , Geological Society of America Best undergraduate poster presentation, Lunar and Planetary Science Conference (LPSC), 2017.	Spring 2017
Guy and Joyce Hovis Geology Award , Lafayette College Recognition of achievement in undergraduate research.	Spring 2016
Stephen G. Pollock Undergraduate Research Grant , Geological Society of America Funding was used to travel to Alaska and collect tephra samples for a summer research project. Preliminary findings presented at GSA 2016, Boulder, CO.	Spring 2015

FIRST AUTHOR PAPERS (PEER-REVIEWED)

- 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).
- Sosa, E. S.**, Bucholz, C. E., Hernández-Montenegro, J. D., Kipp, M. A., Tissot, F. L., Ratschbacher, B. C., ... & 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).
- Sosa, E. S.**, Bucholz, C. E., Barickman, M. H., VanTongeren, J. A., Setera, J. B., Kay, S. M., & Kay, R. W. (2023). Petrology and geochemistry of Adak Island plutonic xenoliths: implications for primitive magma generation and crustal differentiation in the Aleutian Island arc. *Journal of Petrology*, 64(10).

SELECTED RESEARCH EXPERIENCES

Fe isotope fractionation during densification of metamorphic xenoliths: Caltech 2022 - 2024
Separated and purified iron from bulk-rock powders and mineral separates (garnet, amphibole, pyroxene) from mid/lower-crustal Andean xenoliths (i.e., "arclogites"). Combined thermodynamic Perple_X modeling with fundamental isotopic theory to show that the many garnet clinopyroxenite rocks in the lower Andean crust likely formed through amphibole dehydration reactions. Integrated Fe isotope results with major/trace element mineral chemistry, geothermal barometry, petrography, and whole-rock chemistry to develop and support conclusions. Results published in [Earth and Planetary Science Letters](#).

Fe isotope systematics of lower crustal igneous xenoliths: Caltech 2020 - 2024
Separated and purified iron from bulk-rock powders and mineral separates (olivine, pyroxene, spinel, magnetite, amphibole) from igneous mid/lower-crustal Aleutian Arc xenoliths. Showed through mass balance modeling how magmas may experience periods of isotopic enrichment or depletion as the crystallizing mineral assemblage changes. Led the creation of laboratory and analytical procedures for Fe isotope analysis at Caltech, including creating data reduction codes, procuring and preparing Fe reference material, and cross-calibrating them with standards from external labs. Findings were presented at the 2022 Goldschmidt Conference in Honolulu, HI. Results published in [Geochimica et Cosmochimica Acta](#).

Crystallization conditions at the base of the Aleutian Arc crust: Caltech 2018 - 2023
Collected in-situ mineral trace and major element chemistry and used data to estimate crystallization conditions (pressure, temperature, water content, oxygen fugacity) under which Aleutian Arc xenoliths formed. Led in the creation of a set of secondary spinel standards for EPMA whose $Fe^{+3}/\Sigma Fe$ ratios had been previously measured with synchrotron Mössbauer spectroscopy (SMS) to allow other Caltech researchers to more accurately assess iron speciation in Fe-Ti oxides in future oxybarometry studies. Results published in [Journal of Petrology](#).

$Fe^{+3}/\Sigma Fe$ ratios in amphibole: Caltech Summer 2018
Assisted Caltech postdoc perform single-crystal SMS at Argonne National Laboratory. Data was used to calculate $Fe^{+3}/\Sigma Fe$ ratios in amphibole grains and later employed in Sosa et al. (2024, GCA) to estimate the force constant of iron bonds in the amphibole lattice structure.

Senior Honors Thesis: Lafayette College 2016 – 2017
Used zircon minerals separated from outwash deposits to study the glacially obscured Öräfajökull volcano in southwestern Iceland. Collected trace element data from zircon at Stanford using sensitive high-resolution ion microprobe-reverse geometry (SHRIMP-RG). Results were presented at the 2017 GSA Joint Section Meeting in Pittsburgh, PA.

Natural History Research Experience (NFS-REU) Fellow: Smithsonian Institution, NMNH Summer 2016
Performed partial melting experiments on chondrites to explore temperature and oxygen fugacity conditions under which the oligoclase-rich achondrites Graves Nunataks 06128 and 06129 formed. Findings presented at the Council for Undergraduate Research REU symposium at the National Science Foundation headquarters in Alexandria, Virginia, and the 2017 Lunar & Planetary Science Conference in Houston, TX. Results published in [Geochimica et Cosmochimica Acta](#).

EXCEL Research Scholar: Lafayette College Summer 2015
Assisted in developing a project using zircon trace element and isotope geochemistry to link orphaned ash beds to their source volcanoes. Established laboratory protocols for zircon mineral separation at Lafayette College. Results were presented at the GSA Annual Meeting in Denver, CO.

SELECTED FIELD EXPERIENCES

Metamorphic geology field mapping, Assynt, Scotland (2 weeks, University of Oxford)	<i>Spring 2022</i>
Sedimentary and structural geology field mapping, Wheeler Ridge AZ (10 days, Caltech)	<i>Spring 2019</i>
Structural geology field mapping, Bishop, CA (10 days, Caltech)	<i>Fall 2018</i>
Amargosa River hydrologic field survey, Death Valley, CA (10 days, Caltech)	<i>Fall 2017</i>
Structural geology field mapping, Sheep Mountain, WY (5 days, Lafayette College)	<i>Fall 2015</i>
Volcanic ash collection, Fairbanks, AK (5 days, Lafayette College)	<i>Summer 2015</i>
Field class, the Andes and Galapagos Islands, Ecuador (3 weeks, Lafayette College)	<i>Winter 2015</i>

SELECTED TEACHING AND MENTORING

Metamorphic Petrology teaching assistant (Caltech) *Spring 2022*
Teaching assistant and laboratory instructor. Designed new laboratory exercises for students and led laboratory instruction. Graded labs and homework. Created practical lab final for the class.

Structural Geology teaching assistant (Lafayette College) *Fall 2016*
Teaching assistant. Chaperoned field trips, graded lab reports and problem sets, and helped students write a 60-80-page report on the formation of the Sheep Mountain Anticline based on a week-long field experience in the Big Horn Basin, WY.

Introduction to Geology teaching assistant (Lafayette College) Fall 2014
Assisted a first-year faculty member in teaching an introductory geology lab. Helped set labs up, grade lab reports, and brainstorm future improvements to lab exercises.

Research mentor: taught students laboratory techniques and helped them define the scopes of their projects, write reports, and create research presentations.

Odalys Callejas: WAVE undergraduate research fellow (Caltech)

Summer 2021

Allyson Trussell: undergraduate research assistant (Caltech)

Fall 2017

SELECTED SERVICE, LEADERSHIP, AND OUTREACH EXPERIENCES

Event volunteer, ArtNight Pasadena 2024 – present
Assistant art teacher for outreach craft events.

Union Station Adopt-a-meal, Caltech Y 2023 – present
A monthly event where 4-6 members of the Caltech community prepare dinner for 30-40 Pasadena Union Station Homeless Services organization residents. Regularly participates in this event both as a team member and in the primary leadership role.

Invited speaker, GPS Open House, Caltech Spring 2023
Inaugural outreach event speaker for this new community engagement program within the GPS division. Spoke to children 6+ years old about art and science opportunities at Caltech.

Caltech Letters Illustrator, Caltech 2020 – 2021
Illustrator for science communication publication [Caltech Letters](#).

Chair, Caltech Arts Committee, Caltech Graduate Student Council 2019 – 2022
Organized yearly exhibition of Caltech community art (undergrad, grad students, postdocs, faculty, staff), including event advertising, assembling a submission review committee, arranging collection/return of community art, sizing and printing digital art, installing the gallery, managing event volunteers, and organizing an opening night gala for the exhibit. Designed a website to host a virtual art gallery during the COVID-19 pandemic: [Caltech Community Artists](#).

March for Science, Caltech Spring 2018
Ran booth for day-long educational outreach event at Caltech. Supervised public holding meteorites and answered questions about how meteorites are used to study igneous processes in the solar system.

Project Scientist activity leader, meteoritics, Caltech Spring 2018
Day-long departmental educational outreach event to promote women in STEM. Gave a series of lectures about meteorites to elementary and middle school girls before having them draw the meteorites and make scientific observations about samples.

Member of Caltech Women in GPS (WINGS), Caltech 2017 – 2023
Advocacy group promoting the opportunities for women in geosciences at Caltech and beyond through outreach, mentoring, and strengthening the departmental community.
Personal contribution: organized coffee hours where guest speakers and students could discuss issues in academia.

Natural History Research Experiences (NHRE) outreach day, Smithsonian Summer 2016
Day-long educational outreach event at the Smithsonian National Museum of Natural History, allowing museum visitors to hold and interact with meteorites while educating them about Smithsonian research program.

Geology Club Secretary, Lafayette College 2015 – 2016
Coordinated activities and programs related to the geological sciences.

COAUTHOR PAPERS (PEER-REVIEWED)

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

Lunning, N. G., Gardner-Vandy, K. G., **Sosa, E. S.**, McCoy, T. J., Bullock, E. S., & Corrigan, C. M. (2017). Partial melting of oxidized planetesimals: An experimental study to test the formation of oligoclase-rich achondrites Graves Nunataks 06128 and 06129. *Geochimica et Cosmochimica Acta*, 214, 73-85.

CONFERENCE ABSTRACTS

AGU Fall Meeting 2022: Ratschbacher, B. C., **Sosa, E. S.**, Bucholz, C. E., Toellner, T. (2022) Characterization of lower crustal arc cumulate amphiboles (H₂O content, δ D, Fe³⁺/Fe^T ratios) by a combination of microanalytical techniques on single crystals.

Goldschmidt Conference 2022: **Sosa, E. S.**, Bucholz, C. E., Hernández-Montenegro, J. D., Tissot, F. L. H., Kipp, M. A., Kay, S. M., Kay, R. (2022) Iron isotopes in mantle and cumulate xenoliths from Adak Island, Central Aleutians.

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

Cordilleran GSA 2017: Carley, T. L., **Sosa, E. S.**, Banik, T. J., Coble, M. A., Fisher, C. M., Miller, C. F. (2017) Combined insight from tephra and glacially-derived sediments: A zircon-based study of Öräfajökull, SE Iceland.

IAVCEI Volcano Mapping Workshop 2017: Carley, T. L., Banik TJ, **Sosa, E. S.**, Coble, M. A. (2017) Altered, eroded, obscured by ice: A detrital zircon perspective into Iceland's rhyolitic history.

NE GSA 2017: DeBarba, W. P., Carley, T. L., Pamukcu, A.S., Banik, T. J., **Sosa, E. S.**, Tittle, L. R. (2017) Geothermobarometry of glacial outwash sediment from Öräfajökull, Iceland.

NE GSA 2017: **Sosa, E. S.**, Carley, T. L., Banik, T. J., Claiborne, L. L., Miller, C. F. (2017) A detrital zircon investigation into the magmatic history of the Öräfajökull volcano in Southeastern Iceland.

LPSC 2017: **Sosa E. S.**, Lunning N. G., McCoy T. J., Bullock E. S., Corrigan C. M., Gardner-Vandy, K. G. (2017) Constraining the petrogenesis of the paired achondrites GRA 06128/9 through partial melting of an oxidized chondrite.

GSA 2016: **Sosa, E. S.**, Carley, T. L., Jensen, B. J. L., Coble, M. A. (2016) A zircon-based investigation into the tephra of uncertain origins: A case study with the Old Crow Tephra in Central Alaska.