# Michael A. Stewart

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School of Earth, Society and Environment
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## EDUCATION

**Ph.D., Igneous Geochemistry, Duke University (2000)**

*Advisors*: Prof. Emily Klein and Prof. Jeff Karson

*Dissertation*: The Geochemistry of Dikes and Lavas from Hess Deep: Implications for Crustal Construction Processes Beneath Mid-Ocean Ridges, and the Stable-Chlorine Isotope Geochemistry of Mid-Ocean Ridge Basalt Glasses.

**M. S., Igneous Petrology, Indiana University (1992)**

*Advisor*: Prof. Jim Brophy

*Thesis*: Petrogenesis of High Alumina Flood Basalts, Steens Mountains, Oregon.

**B. S., Geology, Indiana University (1990)**

*Research:* Prof. Donald Hattin

*Thesis*: Paleoshoreline Reconstruction of The Cretaceous Interior Seaway From Petrographic Analysis of Jt-1 Member of the Jetmore Limestone

## APPOINTMENTS

### Current Academic

- Clinical Associate Professor, Department of Geology, University of Illinois (2017 - present)
- Co-Director, Wasatch Uinta Field Camp, Park City, Utah (2018 - present)

### Previous Academic

- Faculty, Wasatch Uinta Field Camp, Park City, Utah (2008 - 2018)
- Clinical Assistant Professor, Department of Geology, University of Illinois (2012 - 2017)
- Lecturer, Department of Geology, University of Illinois (2003 - 2012)
- Lecturer, Division of Earth and Ocean Sciences, Duke University (2000 - 2003)
- Visiting Instructor, Department of Geological Sciences, University of North Carolina (2000)
- Research Assistant, Division of Earth and Ocean Sciences, Duke University (1997- 2000)
- Teaching Assistant, Division of Earth and Ocean Sciences, Duke University (1995 -1997)
- Assistant Instructor, Department of Geological Sciences, Indiana University (1990 – 1992)
- Assistant Field Camp Instructor, Judson Mead Field Station, White Hall, MT (1991)

### Previous Professional

- Environmental Project Geologist, Environmental Resources Management, North Central, Deerfield, IL (1992 – 1995)
- National Association of Geoscience Teachers – Unites States Geological Survey Summer Internship, Menlo Park, CA (1990)

## Current Research Interests

IGNEOUS AND METAMORPHIC PETROLOGY

Investigation of chemical interactions between mafic enclaves and their host granites using elemental and isotopic compositional variations to test the operation of *thermal migration zone refining* processes.

Investigation of upper crustal igneous processes in convergent margin tectonic settings through detailed compositional and isotopic variations of associated dikes and hypabyssal stocks exposed in the Wasatch Range of central Utah.

GEOCHEMISTRY

Melting dynamics and the sulfur cycle on Jupiter's moon, Io. Theoretical and experimental investigation of redox melting induced by recycling of elemental sulfur to the mantle through vertical tectonics.

Stable chloride isotope systematics in igneous and metamorphic systems. Determine fractionation factors between associated mineral phases. Develop geochemical criteria to investigate exchange and diffusive processes in igneous systems, and to distinguish mantle source characteristics and histories.

## Research Techniques

- Major element composition of rock samples: preparation and analysis by SEM, DCP, and ICP.
- Trace element composition of rock samples: preparation and analysis by ICP-MS, DCP, GC.
- Chloride stable-isotope composition of rock samples: preparation by pyrohydrolisis and chromatography, and analysis by TIMS

# PUBLICATIONS

## Peer Reviewed Publications *†indicates student co-author, * indicates invited paper*

†Battaglia, S. M., **M. A. Stewart**, S. W. Kieffer, *Io's theothermal (sulfur) – lithosphere cycle inferred from sulfur solubility modeling of Pele's magma supply*, Icarus, 235, 123-129, 2014 ***(Awarded Pellas-Ryder Award from The Meteoritical Society and the Geological Society of America for Best Student Paper in Planetary Sciences)***

Stevenson, M., Y. Leilei, and **M. A. Stewart**, *X-ray tomography verification for determining phase proportions in volcanic rocks*, Proceedings of SPIE, Vol. 7804, doi: 10.1117/12.862109, 2010

***Stewart, M. A.**, Karson, J.K., & Klein, E.M., *Four-dimensional upper crustal construction at fast-spreading mid-ocean ridges: A perspective from an upper crustal cross-section at the Hess Deep Rift*, J.Volcanol. Geotherm. Res., 144, 287-309, 2005.

***Stewart, M. A.,** and A. J. Spivack, *The Stable-Chlorine Isotope Compositions of Natural and Anthropogenic Materials*, Reviews in Mineralogy and Geochemistry, v. 55, p. 231-254, 2004.

**Stewart, M. A.**, Klein, E.M., Karson, J.K., & Brophy, J.G., *Geochemical Relationships Between Dikes and Lavas at The Hess Deep Rift: Implications for Magma Eruptibility*, J. Geophys. Res., v. 108, no. B4, 2184, doi: 10.1029/2001JB001622, 2003

Karson, J.A., E.M. Klein, S.D Hurst, C.E. Lee, P.A. Rivizzigno, D. Curewitz, A.R. Morris, D.J. Miller, R.G. Varga, G.L. Christeson, B. Cushman, J.M. O'Neill, J.G. Brophy, K.M. Gillis, **M.A. Stewart**, *Structure of uppermost fast-spread oceanic crust exposed at the Hess Deep Rift: Implications for subaxial processes at the East Pacific Rise*, Geochem. Geophys. Geosyst., v. 3, no. 1, 1002, doi 10.1029/2001GC000155, 2002

**Stewart, M. A.,** Klein, E.M. & Karson, J.K., *The geochemistry of dikes and lavas from the north wall of the Hess Deep Rift: Insights into the four-dimensional character of crustal construction at fast-spreading mid-ocean ridges*, J. Geophys. Res., v. 107, No. B10, 2238, doi 10.1029/2001JB000545, 2002.

Gillis, K. M., K. Muchlenbachs, **M. A. Stewart**, T. Gleenson, J. Karson, *Fluid flow patterns in fast spreading East Pacific Rise Crust exposed at Hess Deep*, J. Geophys. Res., v.106, 26311-26329, 2001.

Boudreau, A.E., **Stewart, M. A.**, & Spivack, A.J., *Stable Cl isotopes and origin of high-Cl magmas of the Stillwater Complex, Montana,* Geology, v.25, n.9, p. 791-794, 1997.

## National Meeting Abstracts †*indicates student co-author*

†Noethe, S. A., **Stewart, M. A**., Burmeister, K.C., Severson, A.R., *Petrographic and Geochemical Analysis of Igneous Dikes and Keiths Dome Pluton in the Grass Lake Area in the Mount Tallac Roof Pendant; Eldorado Co., California,* Geological Society of America Abstracts with Programs. Vol. 48, No. 5, doi: 10.1130/abs/2016NC-275490, 2016

†Robinson, J.M., †Jones, A.D., Burmeister, K.C., †Severson, A.R., †Noethe, S.A. and **Stewart, M.A.**, *Preliminary Outcrop-Scale RF/Phi Petrofabric Analysis of Conglomerate From the Jurassic Tuttle lake Formation; Mount Tallac Roof Pendant El Dorado County, Ca:* Geological Society of America Abstracts with Programs Vol. 48, No. 7, doi: 10.1130/abs/2016AM-280661, 2016.

†Reinhard, A.A. and **Stewart, M.A.**, *Petrogenesis of Intermediate Stocks and Dikes on Bonanza Ridge, Summit and Wasatch Counties, Utah*, Geological Society of America Abstracts with Programs 46, No. 6, p.552, 2014.

†Severson, A.R., †Klemm, B.M., Burmeister, K.C., †Wilson, A.D., †Noethe, S.A., and **Stewart, M.A.,** *Preliminary geologic map of the Grass Lake area in the southernmost Mount Tallac roof pendant; Desolation Wilderness Area, Eldorado County, California*: *Geological Society of America Abstracts with Programs* 46(6), p. 563, 2014.

Brophy, J. G., **Stewart, M. A.,** "Excess" Plagioclase and Augite in Mid-Ocean Ridge Basalts: An observational and experimental study, EOS Trans. AGU, v. 83, no.47, p. F1419, 2002.

Hanna, H.D., E.M. Klein, C.C. Willmore, **M.A Stewart,** A.E. Boudreau, *Compositional, textural and spatial characteristics of high-level gabbros recovered by submersible from the Hess Deep Rift*, Eos, Trans., AGU, V. 80, p. F985, 1999

**Stewart, M. A.,** Klein, E.M., Karson, The Hess Deep Scientific Party 1999, Major and Trace Element Variations in Dikes Along a 67,000 yr Flowline From the North Wall of Hess Deep: Evidence for Incomplete Along-Axis Mixing in the Axial Magma Chamber, EOS Trans. AGU, v.80, no.46, p.F984, 1999.

**Stewart, M. A.**, Klein, E.M., Spivack, A.J., & Schilling, J.-G., Stable Cl Isotope composition of MOR Basalts from the North Atlantic, EOS Trans. AGU, v.79 no 45, p. F942, 1998.

**Stewart, M. A.**, Klein, E.M., Spivack, A.J., Langmuir, C.H., Karsten, J.L., Bender, J.F., & Magenheim, A.J., Stable Cl isotope compositions of N- and E-MORB glasses, EOS Trans. AGU, v.78, n.17, p.S323 ***[AGU Outstanding Student Paper]*** 1997.

**Stewart, M. A.**, Klein, E.M., Natland, J., Karson, J., & Lonsdale, P., Trace element Variations in Dikes From the North Wall of Hess Deep: Evidence for Short Time-Scale Variations in Magma Composition, EOS, Trans. AGU, v.78, n.46, p. F676, 1997.

**Stewart, M. A.**, Boudreau, A.E., & Spivack, A.J., Cl Isotopes of the Stillwater Complex, Montana, and the Formation of High-Cl Bushveld and Stillwater Parent Liquids During Mantle Metasomatism by Cl-Rich Fluids, EOS Trans. AGU v.77, n.46, p. F829, 1997.

**Stewart, M. A.**, & Brophy, J.G., Petrogenesis of the Steens Mountain Basalts, South-Central Oregon, GSA Annual Meeting Program with Abstracts, v. 27, 434, 1995.

## Local Meeting Abstracts †*indicates student co-author*

†Alvarez, C., †Stirling Lemme, and **M. A. Stewart**, *Development of a method for determining stable-chloride isotope compositions in low-Cl-abundance samples,* LAS Undergraduate Research Symposium, 2017.

†Cui, Y, and **M. A. Stewart,** *Petrogenetic Relationship between Mafic Enclaves, the Alta Stock and Dikes in Albion Basin, Utah,* Research Review, School of Earth Society and the Environment, Univ. of Illinois, 2017.

†Cui, Y, I. †Foli, and **M. S. Stewart**, *Precision and zccuracy of standards based quantitative analysis of plagioclase and andesite whole-Rock ($Li_2B_4O_7$) fusion glasses by SEM*, Research Review, School of Earth Society and the Environment, Univ. of Illinois, 2017.

†Greaney, A. and **M. A. Stewart,** *A petrographic and major element analysis of the origin of dikes and enclaves in the Tertiary Alta Stock exposed at the Albion Basin, Utah*, Research Review, School of Earth Society and the Environment, Univ. of Illinois, 2014. **(Awarded L. Austin Weeks Grant by the American Association of Petroleum Geologists for her academic achievements including this research project.)**

†Reinhard, A.A. and **Stewart, M.A.**, *Petrogenesis of Intermediate Stocks and Dikes on Bonanza Ridge, Summit and Wasatch Counties, Utah*, Research Review, School of Earth Society and the Environment, Univ. of Illinois, 2014.

†Battaglia, S. M., **M. A. Stewart**, S. W. Kieffer, Sulfur cycling on Io: An analogy to Earth's hydro-tectonic cycle, Research Review, School of Earth Society and the Environment, Univ. of Illinois, 2012. ***[Awarded Second]***

†Gountanis, S. and **Stewart, M. A.**, Attitude and opinion of undergraduate students at UIUC regarding climate change and sustainability issues, *Research Review*, School of Earth Society and the Environment, Univ. of Illinois, 2010. ***[Awarded Second]***

†Rosenblume, J., and **Stewart, M. A.**, Analysis of Metamorphism Found in the Alta Contact Aureole, College of Liberal Arts and Sciences Undergraduate Research Symposium, Univ. of Illinois, 2009.

†Quinn, R., and **Stewart, M. A**., Variations in Incompatible Volatile Element Concentration in the Sonju Lake Intrusion, MN, College of Liberal Arts and Sciences Undergraduate Research Symposium, Univ. of Illinois, 2009.

†Nowak, D. J., and **Stewart, M. A.**, Hydrothermal redistribution and separation of halogen elements from platinum group elements within the Sonju Lake Intrusion, MN, *Research Review*, Dept. Geology, Univ. of Illinois, 2007.

†Voigt, K., and **Stewart, M. A.**, Primary phase fractionation control on the eruptibility of magma is dependant on tectonic setting, *Research Review*, Dept. Geology, Univ. of Illinois, 2007.

†Bellucci, J. J., and **Stewart, M. A**, Stable chloride isotopic analysis of the Sonju Lake Intrusion, *Research Review*, Dept. Geology, Univ. of Illinois, 2006.

†Bellucci J. J., and **Stewart, M. A**, Measurement of the Stable-Cl Isotope Composition of Geologic Materials with Low-Chloride Abundance, *Research Review*, Dept. Geology, Univ. of Illinois, 2005.

# ADVISING OF STUDENT RESEARCH

## Graduate Research

1. Nicholas Hugget, Geology Masters Thesis, Making oceanic plagiogranite bodies by thermal migration: evidence from the Agros transect, Troodos Ophiolite, Cyprus (Thesis Reader, 2015).

2. Kelsey Kehoe, Geology Masters Thesis, Investigation of iron isotope variability in the bimodal Aztec Wash Pluton, Eldorado Mountains, Nevada (Thesis Reader, 2014).

3. Norbert A. Gajos, Geology Masters Thesis, Spatially Controlled Fe Isotope Variations at Torres del Paine. (Thesis Reader 2014)

4. Christopher Majercyzky, Geology Masters Thesis, Geology of the Roberts Hill area in the Hudson Valley fold thrust belt, Green County, eastern New York. (Thesis Reader, 2011)

## Undergraduate Research

1. Cristopher Alvarez – Geology, Senior Thesis: Development of a method for determining stable-chloride isotope compositions in low-Cl-abundance samples. (2016-2018).

2. Yunhe Cui – Geology, Petrogenetic Relationship between Mafic Enclaves, the Alta Stock and Dikes in Albion Basin, Utah. (2016-2018)

3. Isaac Foli – Geology, Senior Thesis: The Petrogenesis of Intermediate Stocks and Dikes of the Wasatch Igneous Belt, Central Wasatch Range of Utah. (2016-2017)

4. Samuel Noethe – Geology, Senior Thesis: Petrology and geochemistry of metamorphics, granitoid stocks and andesitic dikes of the Grass Lake area of Mt Tallac roof pendant, Desolation Wilderness Area, Eldarado County, CA. (2014 – 2016)

5. Allison Greaney – Geology, Senior Thesis: A petrographic and major element analysis of the origin of dikes and enclaves in the Alta Stock exposed at the Albion Basin, Utah. (2012 - 2014)

6. Andrew Reinhard – Geology, Senior Thesis: Petrogenesis of intermediate stocks and dikes on Bonanza Ridge, Summit and Wasatch Counties, Utah. (2013 - 2014)

7. Steven Batagllia – Geology, Senior Thesis: Sulfur cycling in Io's lithosphere inferred from sulfur solubility model of Pele's lava lake. (Co-advisor Prof. Sue Keiffer, 2011 - 2012)

8. Amanda Peters – Geology, Late Wisconsinan Paleoecology/Paleoclimate based on terrestrial gastropods, western Kentucky, (co-advised, 2008)

9. Ryan Quinn – Geology, Senior Thesis: Variations in incompatible volatile element concentration in the Sonju Lake Intrusion, MN (2008 - 2009)

10. Justine Rosenblum – Geology, Independent Study: Analysis of metamorphism found in the Alta contact Aureole, Albion Basin UT (2009)

11. Justine Rosenblum – Geology, Independent Study: Analysis of Cross-cutting relationships found in the upper unit of the Searchlight Pluton, southern Nevada (2008)

12. Donald Nowak – Geology Senior Thesis: Hydrothermal redistribution and separation of halogen elements from platinum group elements within the Sonju Lake Intrusion, MN (2006 - 2008)

13. Kelley Voigt – Geology, Senior Thesis: Primary phase fractionation control on the eruptability of magma is dependent on tectonic setting (2008)

14. Jeremy Bellucci – Geology, Senior Thesis: Stable chloride isotopic analysis of the Sonju Lake Intrusion (2005 - 2006).

## James Scholar Honors Projects

### *Geology Research Papers*

1. Allison Greany – Geology 432: Plagioclase composition in igneous rocks of Albion Basin, UT, 2012

2. Elizabeth Kim – Geology 103: Earthquakes in the Midwest, 2007

3. Stephanie OldenKamp – Geology 117: Climate change and increasing tropical cyclone intensity, 2007

4. Melissa Smoler – Geol 208: Developed teaching lesson plans for middle-school Earth Science curriculum. 2006

5. Diana Xu – Geology 100: Current thoughts on comets and the origin of Earth's water and life on Earth, 2006

6. Goylette Chami – Geology 103: Current state of petroleum availability, refining and gas prices and alternative fuel sources, 2005

7. Michelle Daily – Geology 117: The Jellyfish *Velella Velella*: “By the Wind Sailor”, 2005

8. Katherine Reynolds – Geology 100: Evolution of Mammals, 2005

9. John Cunningham – Geology 100: Volcanic eruptions, volatile effects and tectonic settings, 2004

10. Bryan Maguire – Geology 100: Gemstones: formation processes and political and societal issues, 2004

11. Emilie Pannell – Geology 100: The formation of the Grand Canyon with respect to the Colorado Plateau and Colorado River, 2004.

12. Ashley Poynter – Geology 103: Alfred Wegener and The Continental Drift Hypothesis, 2004

13. Kimberly Santangelo – Geology 100: Creationism: a geologically unsound theory, 2004

14. Karen Wong – Geology 108: The Progression of Geotectonic Theories: Investigation of Mountain Building Mechanisms, 2004

***Informal Survey: University of Illinois undergraduate student’s knowledge of climate change and University of Illinois mitigation efforts***

15. Dan Obeler, 2007
16. Ryan McCoy, 2008
17. Meagan Rodriguez, 2008
18. Serena Gountanis, 2009
19. Ariel Ranieri, 2010
20. Madeleine Lynnch, 2010
21. Gabriela Ravayo, 2011
22. Kimberly Gleeson, 2011
23. Megan Mocogni, 2012

# AWARDS AND HONORS

1. University of Illinois at Urbana-Champaign Excellence in Undergraduate Teaching awarded 2/26/2020
2. University of Illinois List of Teachers Ranked as Excellent by Students
   *Rated > 4.5/5 for teaching effectiveness; * indicates rated in top 10% of excellent teachers*

   Planet Earth, Quantitative Reasoning II: 2005
   Oceans: 2016
   History of Earth System: 2005-2008, 2010, 2013, 2015*, 2016, 2018, 2019
   Regional Geology Field Trip, Cyprus: 2011
   Regional Geology Field Trip, Scotland: 2018
   Geologic Field Methods, Western US (Field Camp): 2011, 2016, 2018
   Mineralogy and Mineral Optics: 2012, 2013*, 2014, 2015, 2016, 2017, 2019
   Petrology and Petrography: 2009, 2012*, 2013*, 2019
   Geochemistry: 2008, 2011, 2012*, 2013*, 2014, 2017, 2019

3. University of Illinois United Greek Council Outstanding Faculty Member Award, 2010

4. American Geophysical Union Outstanding Student Paper Award. Given for exemplary scientific merit of paper presented at the Fall Meeting of AGU in San Francisco CA, 1998

5. Indiana University Geological Sciences Faculty Award earned for excellent academic improvement, 1990.

6. NAGT-USGS Summer Internship award for outstanding performance in summer field course, 1990,

# TEACHING EXPERIENCE

## Core and Upper Level Classes ** indicates currently taught on regular basis*

- History of the Earth System, Geology 208*
- Mineralogy and Mineral Optics, Geology 432*
- Regional Geology Field Trip, Geology 415*
- Geologic Field Methods, Western US (Field Camp), Geology 417*
- Petrology and Petrography, Geology 436
- Geochemistry, Geology 460*
- Marine Geology

## Introductory level classes

- Planet Earth, Geology 100
- Planet Earth, Quantitative Reasoning II, Geology 103
- Geology of the National Parks, Geology 104
- The Oceans, Geology 117*
- Natural Disasters

# ACADEMIC WORKSHOPS

- RIDGE Field School participant: The Troodos Ophiolite and Mid-Ocean Ridge Processes, Larnaka, Cyprus, July 1-11, 1999.

- RIDGE/NORDVULK Summer School participant: Active Processes at Mid-Ocean Ridges, Lake Myvatn, Iceland, August 26-September 5, 1997.

# CURRICULUM DEVELOPMENT WORKSHOPS

- Teaching Geoscience in the Field in the 21st Century, National Association of Geoscience Teachers, Montana State University, Bozeman, MT, August, 2010

- Infusing Quantitative Literacy into Introductory Geoscience Courses, National Association of Geoscience Teachers, Carleton College, Northfield, MN, June 2006

# PROFESSIONAL DEVELOPMENT WORKSHOPS

- Focusing the lens on field safety: a workshop for field trip leaders, Univ. of Iowa, Dept. of Earth and Environmental Sciences, Iowa City, Iowa, November, 2019.
- National Outdoor Leadership School (NOLS) Wilderness First Aid, Iowa City, Iowa, November 2019.
- Field Safety Leadership School, ExxonMobil Upstream Geoscience Corp., GSA Annual Meeting, Denver, CO October 2013.
- Early Career Geoscience Faculty: Teaching, Research, and Managing Your Career, National Association of Geoscience Teachers, College of William and Mary, May 2004.

# SERVICE ACTIVITIES

## Departmental Service

Academic Advisor (2007 – present)

Awards Committee Chair (2014 – present)

Awards Committee Member (2007 – 2014)

Undergraduate Committee Member (2007 – present)

Field Camp Coordinator (2006 – 2018)

Field Camp Co-Director and Coordinator (2018 - present)

## Service to Students

Faculty Liaison for the Geology Club (2012 - 2016)

Student Activities Committee Member (2018 – present)

## FIELD TRIPS LEAD

Transect across the Cordilleran Front Range onto the Colorado Plateau 2005-present

Regional Geology of Scotland, 2014, 2018

Troodos Ophiolite, Cyprus, 2011, 2015, 2020

Regional Geology of Sonoran - San Andreas – Mojave, 2006, 2009, 2013

Blue Ridge metamorphic terrane, Brevard Continental Suture Zone, 2009, 2012, 2019

St. Francois Mountains, MO, 2003-present

## OUTREACH

Holy Cross 31st Annual Troup 9 Merit Badge Seminar, Geology certificate class, 2020

Unit 4 Schools High School Earth Science Curriculum Development, 2011

Unit 4 High School Earth Science field trip canoeing Middle Fork River, 2012 – present

International Prep. Academe, Dual Language 5th Grade Class, Kickapoo St Park, 2017

## PROFESSIONAL AFFILIATIONS

- American Geophysical Union, 1990 - present.
- Geological Society of America, 1990 - present.
- National Association of Geoscience Teachers, 2003 - present