

Stephen M. Elardo

Assistant Professor • NASA Early Career Fellow • University of Florida • Department of Geological Sciences

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Education

PhD with Distinction in Earth and Planetary Sciences

University of New Mexico – July 2014

Co-Advisors: Francis McCubbin and Charles Shearer

MSc in Earth and Planetary Sciences

University of New Mexico – July 2010

Co-Advisors: Charles Shearer and David Draper

BSc in Geosciences

Stony Brook University – May 2008

Research Advisors: Hanna Nekvasil, Francis McCubbin, and Don Lindsley

Positions Held

Assistant Professor

Department of Geological Sciences, University of Florida, Aug. 2018 – Present

Post-Doctoral Researcher

Geophysical Laboratory, Carnegie Institution of Washington, Sept. 2014 – Aug. 2018

Mentor: Anat Shahar

Research Associate

Towson University, June 2015 – Aug. 2018

NASA Earth and Space Science Graduate Fellow

University of New Mexico, Sept. 2012 – Aug. 2014

Research Assistant

University of New Mexico, Sept. 2008 – July 2014

Awards & Honors

NASA Early Career Fellowship

Geophysical Laboratory, Carnegie Institution of Washington, 2016

NASA Earth and Space Science Graduate Fellowship

Department of Earth and Planetary Science, University of New Mexico, 2012 – 2014

Vincent C. Kelly PhD Student Award

Department of Earth and Planetary Science, University of New Mexico, 2014

New Mexico Space Grant Fellowship (Twice)

Department of Earth and Planetary Science, University of New Mexico, 2009 & 2012

Vincent C. Kelly MSc Student Award

Department of Earth and Planetary Science, University of New Mexico, 2010

Oliver Schaffer Award

Department of Geosciences, Stony Brook University, 2008

Proposals, Grants & Fellowships

Total Funded to Date: \$432,475

NSF GEOPaths Program

GP-GO: GeoScientists Promoting Accessible Collaborative Education (GEOSPACE), Anita Marshall – PI, S. M. Elardo – Co-PI, Total Budget:

NASA Solar System Workings Program

Testing Models of the Origin and Global Distribution of the Lunar Mg-Suite, S.M. Elardo – PI, 2016 – 2021, Total Budget \$249,775

NASA Early Career Fellowship

Provides \$100,000 in Start-Up Funds for a Tenure-Track or Equivalent Permanent Position

NASA Earth and Space Science Fellowship

Exploring the Interior of the Moon: A Perspective from Lunar Meteorites, 2012 – 2014, Total Budget \$60,000

New Mexico Space Grant Consortium Graduate Fellowship (Twice)

University of New Mexico, 2009 and 2012, Total Combined Budget: \$20,000

Second Conference on the Lunar Highlands Crust Travel Grant

Lunar and Planetary Institute, 2012

Research Project and Travel Grant

University of New Mexico, 2010

VEXAG/Venus Geochemistry Workshop Travel Grant

Lunar and Planetary Institute, 2009

Publications

Total: 26 – Current h-Index: 17 (Google Scholar), **17** (Web of Science)
Current Citation Totals: 1412 (Google Scholar), **1203** (Web of Science)
[Link to Google Scholar](#) – [Link to ORCID](#)

Book Chapters

- [4] **Elardo, S. M.**, Pieters, C., Dhingra, D., Donaldson Hanna, K. L., Glotch, T. D., Greenhagen, B. T., Gross, J., Head, J. W., Jolliff, B. L., Klima, R. L., Magna, T., McCubbin, F. M., and Ohtake, M. (In Revision) The Evolution of the Lunar Crust. In *New Views of the Moon 2 – Reviews in Mineralogy and Geochemistry*. Volume currently in writing stage.
- [3] McCubbin, F. M., Barnes, J. J., Ni, P., Hui, H., Klima, R. L., Burney, D., Day, J. M. D., Magna, T., Boyce, J. W., Tartèse, R., Vander Kaaden, K E., Steenstra, E., **Elardo, S. M.**, Zeigler, R. A., Anand, M., and Liu, Y. (In Revision) Endogenous lunar volatiles. In *New Views of the Moon 2 – Reviews in Mineralogy and Geochemistry*. Volume currently in writing stage.
- [2] Shahar, A., **Elardo, S. M.** and Macris, C. A. (2017) Equilibrium Fractionation of Non-Traditional Isotopes: An Experimental Perspective. In *Measurements, Theories and Applications of Non-Traditional Stable Isotopes – Reviews in Mineralogy and Geochemistry*, Vol. 82, Chapter 3, 65-83. Mineralogical Society of America. [Link to Chapter](#)
- [1] **Elardo, S. M.** (2016) Lunar Magma Ocean Theory, Origins and Rationale. *Encyclopedia of Lunar Science*. Ed. Cudnik, B. Springer International Publishing. DOI: 10.1007/978-3-319-05546-6_25-1 [Link to Chapter](#)

Peer-Reviewed Papers

- [22] Reagan, M. M., Shahar, A., **Elardo, S. M.**, Gleason, A. E., Liu, J., and Mao, W. L. (In Revision) The effect of nickel on iron isotope fractionation at high pressure. *Geophysical Research Letters*
- [21] **Elardo, S. M.**, Laneuville, M., McCubbin, F. M., and Shearer, C. K. (2020) Early crust building enhanced on the Moon's nearside by mantle melting point depression. *Nature Geoscience*, **13**, nr. 5, 339-343. [Link to Paper](#) [Link to UF Press Release](#)
- [20] **Elardo, S. M.**, Shahar, A., Mock, T. M., and Sio, C. K. (2019) The effect of core composition on iron isotope fractionation between planetary core and mantles. *Earth and Planetary Science Letters*, 513, 124-134. [Link to Paper](#)
- [19] McCubbin, F. M., Vander Kaaden, K. E., Peplowski, P. N., Bell, A. S., Nittler, L. R., Boyce, J. W., Evans, L. G., Keller, L. P., **Elardo, S. M.**, and McCoy, T. J. (2017) A low O/Si ratio on the surface of Mercury: Evidence for silicon smelting? *Journal of Geophysical Research – Planets*. 122, 2053-2076. 10.1002/2017JE005367 [Link to Paper](#)
- [18] **Elardo, S. M.** and Shahar, A. (2017) Non-chondritic iron isotope ratios in planetary mantles as a result of core formation. *Nature Geoscience*. 10, nr. 4, 317 - 321. [Link to Paper](#) [Link to News and Views Article](#) [Link to April Issue Cover Image](#)
- [17] McCubbin, F. M., Boyce, J. W., Novák-Szabó, T., Santo, A. R., Tartèse, R., Muttik, N., Domokos, G., Vazquez, J., Keller, L. P., Moser, D. E., Jerolmack, D. J., Shearer, C. K., Steele, A., **Elardo, S. M.**, Rahman, Z., Anand, M., Delhaye, T., and Agee, C. B. (2016) Geologic history of martian regolith breccia Northwest Africa 7034: Evidence for hydrothermal activity and lithologic diversity in the martian crust. *Journal of Geophysical Research – Planets*. 121, 2120-2149, doi:10.1002/2016JE005143 [Link to Paper](#)
- [16] McCubbin, F. M., Boyce, J. W., Srinivasan, P., Santos, A. R., **Elardo, S. M.**, Filiberto, J., Steele, A., and Shearer, C. K. (2016) Heterogeneous distribution of H₂O in the martian interior: Implications for the abundance of H₂O in depleted and enriched mantle sources. *Meteoritics and Planetary Science*. 51, Nr.11, 2036-2060. [Link to Paper](#)
- [15] Shearer, C. K., **Elardo, S. M.**, Petro, N. E., Borg, L. E., and McCubbin, F. M. (2015) Origin of the lunar highlands Mg-suite: An integrated petrology, geochemistry, chronology, and remote sensing perspective. *American Mineralogist* 100, 294-325. *Special Issue: Second Conference on the Lunar Highlands Crust and New Directions. Invited Review Paper* [Link to Paper](#)
- [14] **Elardo, S. M.**, Shearer, C. K., Vander Kaaden, K. E., McCubbin, F. M., and Bell, A. S. (2015) Petrogenesis of primitive and evolved basalts in a cooling Moon: Experimental constraints from the youngest known lunar magmas. *Earth and Planetary Science Letters* 422, 126-137. [Link to Paper](#)
- [13] McCubbin, F. M., Vander Kaaden, K. E., Tartèse, R., Klima, R. L., Liu, Y., Mortimer, J., Barnes, J. J., Shearer, C. K., Treiman, A. H., Lawrence, D. J., **Elardo, S. M.**, Hurley, D. M., Boyce, J. W., and Anand, M. (2015) Volatiles (H, C, N, F, S, Cl) in the lunar mantle, crust, and regolith: Distribution, processes, sources, and significance. *American Mineralogist* 100, 1668-1707. *Special Issue: Second Conference on the Lunar Highlands Crust and New Directions. Invited Review Paper* [Link to Paper](#)
- [12] McCubbin, F. M., Shearer, C. K., Burger, P. V., Hauri, E. H., Wang, J., **Elardo, S. M.**, and Papike, J. J. (2014) Volatile abundances of coexisting merrillite and apatite in the martian meteorite Shergotty: Implications for merrillite in hydrous magmas. *American Mineralogist* 99, 1347-1354. [Link to Paper](#) [Link to Highlights and Breakthroughs Article](#)

- [11] Tartèse, R., Anand, M., McCubbin, F. M., **Elardo, S. M.**, Shearer, C. K., and Franchi, I. A. (2014) Apatites in lunar KREEP basalts: The missing link to understanding the H isotope systematics of the Moon. *Geology* 42, no. 4, 363-366. [Link to Paper](#)
- [10] **Elardo, S. M.**, Shearer, C. K., Fagan, A. L., Borg, L. E., Gaffney, A. M., Burger, P. V., Neal, C. R., Fernandes, V. A., and McCubbin, F. M. (2014) The origin of young mare basalts inferred from lunar meteorites Northwest Africa 4734, 032, and LaPaz Icefield 02205. *Meteoritics & Planetary Science* 49, Nr. 2, 261-291. [Link to Paper](#)
- [9] **Elardo, S. M.** and Shearer, C. K. (2014) Magma chamber dynamics recorded by oscillatory zoning in pyroxene and olivine phenocrysts in lunar basaltic meteorite Northwest Africa 032. *American Mineralogist* 99, 355-368. [Link to Paper](#) [Link to Highlights and Breakthroughs Article](#)
- [8] McCubbin, F. M., **Elardo, S. M.**, Shearer, C. K., Smirnov, A., Hauri, E. K., and Draper, D. S. (2013) A petrogenetic model for the co-magmatic origin of chassignites and nakhlites: Inferences from chlorine-rich minerals, petrology, and geochemistry. *Meteoritics & Planetary Science* 48, Nr. 5, 819-853. [Link to Paper](#)
- [7] Agee, C. B., Wilson, N. V., McCubbin, F. M., Ziegler, K., Polyak, V. J., Sharp, Z. D., Asmerom, Y., Nunn, M. H., Shaheen, R., Thiemens, M. H., Steele, A., Fogel, M. L., Bowden, R., Glamoclija, M., Zhang, Z., and **Elardo, S. M.** (2013) Unique Meteorite from Early Amazonian Mars: Water-Rich Basaltic Breccia Northwest Africa 7034. *Science* 339, 780-785. [Link to Paper](#) [Link to Perspectives Article](#)
- [6] **Elardo, S. M.**, McCubbin, F. M., and Shearer, C. K. (2012) Chromite symplectites in Mg-suite troctolite 76535 as evidence for infiltration metasomatism of a lunar layered intrusion. *Geochimica et Cosmochimica Acta* 87, 154-177. [Link to Paper](#)
- [5] McCubbin, F. M., Hauri, E. H., **Elardo, S. M.**, Vander Kaaden, K. E., Wang, J., and Shearer, C. K. (2012) Hydrous melting of the Martian mantle produced both depleted and enriched Shergottites. *Geology* 40, no. 8, 683-686. [Link to Paper](#)
- [4] McCubbin, F. M., Jolliff, B. L., Nekvasil, H., Carpenter, P. K., Zeigler, R. A., Steele, A., **Elardo, S. M.**, and Lindsley, D. H. (2011) Fluorine and chlorine abundances in lunar apatite: Implications for heterogeneous distributions of magmatic volatiles in the lunar interior. *Geochimica et Cosmochimica Acta* 75, 5073-5093. [Link to Paper](#)
- [3] **Elardo, S. M.**, Draper, D. S., and Shearer, C. K. (2011) Lunar Magma Ocean crystallization revisited: Bulk composition, early cumulate mineralogy, and the source regions of the highlands Mg-suite. *Geochimica et Cosmochimica Acta* 75, 3024-3045. [Link to Paper](#)
- [2] Nekvasil, H., McCubbin, F. M., Harrington, A. D., **Elardo, S. M.**, and Lindsley, D.H. (2009) Linking the Chassigny meteorite and the Martian surface rock Backstay: Insights into igneous crustal differentiation processes on Mars. *Meteoritics & Planetary Science* 44, Nr. 6, 853-869. [Link to Paper](#)
- [1] McCubbin, F. M., Nekvasil, H., Harrington, A. D., **Elardo, S. M.**, and Lindsley, D. H. (2008) Compositional diversity and stratification of the Martian crust: Inferences from crystallization experiments on the picobasalt Humphrey from Gusev Crater, Mars. *Journal of Geophysical Research - Planets* 113, E11013, doi:10.1029/2008JE003165. [Link to Paper](#)

Teaching Experience

Mineralogy, GLY3200

Instructor – University of Florida, Fall 2020

Scientific Survival Skills, GLY6932

Instructor – University of Florida, Spring 2020

Physical Geology, GLY2010C

Instructor, Two Sections – University of Florida, Spring 2019

Igneous & Metamorphic Petrology

Graduate Teaching Assistant – University of New Mexico, 2013

Structural Geology

Undergraduate Teaching Assistant – Stony Brook University, 2007

Physical Geology Tutor

Stony Brook University, 2007 – 2008

Students Mentored

Elizabeth Pesar – Primary Advisor, PhD (In Progress)

University of Florida

Daniel Astudillo – Primary Advisor, MSc (In Progress)

University of Florida

Molly Anderson – Co-Advisor with Michael Perfit, PhD (In Progress)

University of Florida

Professional Service

Theme Group Co-Chair, Goldschmidt 2021, Theme 1: *Solar System and Planets*, with T. Kruijer and K. Joy

Co-Convener, Goldschmidt 2020, Session 01a: *Accretion, Differentiation, and Evolution of Rocky Bodies Across the Inner Solar System*, with K. E. Vander Kaaden, K. Iacovino, J. Creech, M. Fischer-Gödde

Science Organizing Committee, *Differentiation: Building the Internal Architecture of Planets*. Lunar and Planetary Institute's First Billion Years Initiative, 2018.

Co-Convener, AGU Fall Meeting 2016, Session V023: *Physical and Chemical Constraints on the Moon-Forming Giant Impact*, with B. Wood, R. Parai, and J. Wade

NASA – ROSES Proposal Reviewer and Panel Member, Seven Panels.

Program Committee, Lunar and Planetary Science Conference, 2015 and 2016

Science Organizing Committee, NASA Exploration Science Forum Meeting, 2015

Peer Reviewer: *Nature Geoscience*, *Geochimica et Cosmochimica Acta*, *Meteoritics & Planetary Science*, *The Journal of Geophysical Research – Planets*, *American Mineralogist*, *Earth & Planetary Science Letters*, *The Journal of Geophysical Research – Solid Earth*, *Reviews in Mineralogy & Geochemistry*, and *Geochemical Perspective Letters*

Invited Talks & Seminars

AGU Fall Meeting, 2020

Invited Talk in Session: *Interiors of Planets and Moons: Learning from Spacecraft Observations, Simulations and In-Situ Data*, Section: Study of Earth's Deep Interior

University of Central Florida

Invited Seminar, Department of Physics, November 2019

50th Lunar and Planetary Science Conference

Invited Talk, Special Session on the 50th Anniversary of Apollo and LPSC

Virginia Tech

Special Invited Seminar, Department of Geosciences, May 2018

49th Lunar and Planetary Science Conference

Invited Talk, Special Session on the 45th Anniversary of Apollo 17, March 2018

University of Oregon

Special Invited Seminar, Department of Earth Sciences, March 2018

University of Florida

Special Invited Seminar, Department of Geological Sciences, February 2018

Towson University

Invited Seminar, Department of Physics, Astronomy & Geosciences, December 2017

45th Anniversary Symposium for Apollo 17

Invited Talk, Goddard Spaceflight Center, May 2017

2017 Goldschmidt Conference

Invited Talk in Session 01g: *Stable Isotope Records of Nebular and Planetary Processes* - Declined

Towson University

Department Seminar, Department of Physics, Astronomy & Geosciences, April 2017

University of Utah

Special Invited Seminar, Department of Geology and Geophysics, Feb. 2017

NASA Lunar Reconnaissance Orbiter Workshop on Young Lunar Volcanism

Invited Talk, Lunar and Planetary Institute, Feb. 2017

University of Tennessee at Knoxville

Special Invited Seminar, Department of Earth and Planetary Sciences, Jan. 2017

Stony Brook University

Department Seminar, Department of Geosciences, Oct. 2016

2016 Goldschmidt Conference

Invited Talk in Session 02g: *Lunar Evolution: Endogenous and Exogenous Processes*

University of Maryland

Geochemistry Seminar, Department of Geology, April 2016

Johns Hopkins Applied Physics Laboratory

Department Seminar, April 2015

Geophysical Laboratory

Invited Talk, Carnegie Institution of Washington, Feb. 2014

University of New Mexico

Institute of Meteoritics Seminar, Regular Speaker

**Press Releases
& Coverage**

"New research provides a clearer view of the Moon's history" by Scott Rogers,
University of Florida News – [Link to Article](#)

“What we’re still learning from Apollo” by Alisson Clark, *University of Florida News* – [Link to Interview Video](#)

“Why Apollo’s Moon rocks still matter” by Alisson Clark, *University of Florida News* – [Link to Article](#)

Quoted in **“How NASA has kept Apollo moon rocks safe from contamination for 50 years”** by Lisa Grossman, *Science News* – [Link to Article](#)

“Why are there different ‘flavors’ of iron around the Solar System?”
Carnegie Institution for Science Press Release for Elardo and Shahr (2017) *Nature Geoscience* – [Link to Press Release](#)

Quoted in **“Iron Isotopes in Planets Key to Formation of Solar System”** by Kaylan Kumar, *Tech Times* – [Link to News Article](#)

“Ancient Water-rich Meteorite Linked to Martian Crust”
UNM Press Release for Agee et al. (2013) *Science* – [Link to Press Release](#)
[Link to an Example of Press Coverage – BBC News](#)

Public Lectures

Carnegie Neighborhood Lecture Series – “The Roadside Geology of Earth’s Moon”
Geophysical Laboratory, Carnegie Institution for Science, November 2017

Invited Talk, “How We Know Martian Meteorites are from Mars”, Meeting of the Albuquerque Astronomical Society, May 2013