

# 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 and Teaching 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**

### **NASA Solar System Workings Program**

*Testing Models of the Origin and Global Distribution of the Lunar Mg-Suite*, S.M. Elardo – PI, 2016 – 2019, Total Budget \$249,775

### **NASA Early Career Fellowship**

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

### **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: 15** (Google Scholar), **14** (Web of Science)

**Current Citation Totals: 987** (Google Scholar), **821** (Web of Science)

[Link to Google Scholar](#) – [Link to Thomson-Reuters ResearcherID](#) – [Link to ORCID](#)

## Book Chapters

- [4] McCubbin, F. M., Liu, Y., **Elardo, S. M.**, et al. (In preparation) Endogenous lunar volatiles. In *New Views of the Moon 2 – Reviews in Mineralogy and Geochemistry*. Volume currently in writing stage.
- [3] **Elardo, S. M.**, Pieters, C., et al. (In preparation) Evolution of the Lunar Crust. 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](#)

## Papers Currently Being Written

- [22] Reagan, M. M., Shahar, A., Gleason, A. E., **Elardo, S. M.**, Liu, J., and Mao, W. L. (2018) The effect of nickel on iron isotope fractionation at high pressure. *In preparation*.
- [21] **Elardo, S. M.**, Laneuville, M., McCubbin, F. M., and Shearer, C. K. (2018) Asymmetric post-magma ocean crust-building on the Moon's nearside. *In preparation*.

## Peer-Reviewed Papers

- [20] **Elardo, S. M.**, Shahar, A., Mock, T. M., and Sio, C. K. (2018) The effect of core composition on iron isotope fractionation between planetary core and mantles. *In Review, Earth and Planetary Science Letters*.
- [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 H<sub>2</sub>O in the martian interior: Implications for the abundance of H<sub>2</sub>O 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

### 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

### Reed Mershon

University of Chicago (now a graduate student at the University of Minnesota)  
Carnegie Summer Interns Program, co-advised with Colin R. M. Jackson

## Professional Service

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 Bernie Wood, Rita Parai, and Jon Wade

NASA Proposal Reviewer and Panel Member, 6 panels

Program Committee, Lunar and Planetary Science Conference 2015 and 2016

Science Organizing Committee, NASA Exploration Science Forum Meeting 2015

Peer reviewer for *Geochimica et Cosmochimica Acta*, *Meteoritics & Planetary Science*, *The Journal of Geophysical Research – Planets*, *American Mineralogist*, *Earth & Planetary Science Letters*, and *The Journal of Geophysical Research – Solid Earth*

## Invited Talks & Seminars

### Virginia Tech

Special Invited Seminar, Department of Geosciences, May 2018

### 49<sup>th</sup> Lunar and Planetary Science Conference

Invited Talk, Special Session on the 45<sup>th</sup> 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

### 45<sup>th</sup> 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 O2g: *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

**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