

CATHERINE M. ELDER

Jet Propulsion Laboratory
M/S 183-301, 4800 Oak Grove Drive
Pasadena, CA 91109
(818) 354-9381 ◊ Catherine.Elder@jpl.nasa.gov

EDUCATION

- 05/2015 **Ph.D. Planetary Sciences (Minor in Geosciences)**
University of Arizona
Dissertation Title: *The Effects of Melt on Impact Craters on Icy Satellites and on the Dynamics of Io's Interior*
- 05/2008 **B.A. Astronomy**
Cornell University

RESEARCH EXPERIENCE

- 2018–Present **Research Scientist**
Planetary Interiors and Geophysics Group
Jet Propulsion Laboratory
- 2015–2018 **Postdoctoral Scholar**
Geophysics & Planetary Geosciences Group
Jet Propulsion Laboratory
- 2009–2015 **Graduate Research Associate**
Department of Planetary Sciences/Lunar and Planetary Laboratory
University of Arizona
- Summer
2006 **Student Undergraduate Internship in Astrobiology (SUIA)**
NASA Goddard Space Flight Center
- 2005–2008 **Undergraduate Research Assistant**
Department of Astronomy
Cornell University

MISSION EXPERIENCE

Europa Clipper

- Investigation Scientist for the Europa Imaging System (EIS) (2019–Present)

NASA Origins, Spectral Interpretation, Resource Identification, Security, Regolith Explorer (OSIRIS-REx)

- Participating Scientist (2017–Present)
- Member of the Thermal Analysis and Regolith Development Working Groups

NASA Lunar Reconnaissance Orbiter (LRO) Diviner Lunar Radiometer Experiment

- Co-I (2018–Present)
- Postdoc (2015–2018)
- Targeting and analyzing nighttime temperature observations to derive thermophysical properties and better understand the material properties of the lunar surface

Intrepid Pre-Decadal Mission Concept Study

- JPL science liaison (2019–2020)

Moon Diver (NASA Discovery proposal)

- Deputy Camera Scientist and regolith theme team member (2018–2019)
- Assisted in the development of the science traceability matrix, acted as a local science resource to the JPL engineering team, participated in the costing of the context cameras, and contributed to preliminary landing site safety assessment.

NASA JPL Planetary Science Summer School (2016)

- Principal Investigator
- Developed a mission concept for a Uranus orbiter.

HONORS AND AWARDS

2018	JPL Voyager Award
2016	JPL Postdoc Research Day Best Planetary Science and Life Detection Poster
2014	American Geophysical Union (AGU) Outstanding Student Paper Award
2014	Uwingu Student Travel Grant
2014	Hartmann Student Travel Award
2013	Lunar and Planetary Institute (LPI)'s Career Development Award
2013	Lunar and Planetary Laboratory (LPL)'s Shandel Travel Award
2012, 2013	University of Arizona Graduate Student Council Travel Grant
2007	NSF Research Experience for Undergraduates
2004–2006	Cornell University Dean's List

INVITED TALKS

2019	Geological Society of America Annual Meeting
2018	Geological Society of America Annual Meeting
2016	American Geophysical Union Fall Meeting
2015	University of California Los Angeles iPLEX seminar
2015	Southwest Research Institute Colloquium

RESEARCH GRANTS

- 2021–2023 **Co-I**, PI: Matt Kenyon, “Next-generation cold object radiometer”, NASA Maturation of Instruments for Solar System Exploration.
- 2019–2022 **PI**, “The Lunar Rock Size-Frequency Distribution and Implications for Rock Breakdown”, NASA Lunar Data Analysis Program.
- 2019–2022 **PI**, “Mapping the Thickness of the Lunar Regolith Using a New Class of Young Craters”, NASA Lunar Data Analysis Program.
- 2017–2020 **PI**, “Boulders on Bennu: Modeling Thermal Emission from Boulders for Yarkovsky Effect and Thermal Inertia Investigations”, NASA OSIRIS-REx Participating Scientist Program.
- 2017–2020 **Science-PI**, PI: Michael Bland, “Silicate Volcanism and the Habitability of Europa’s Seafloor”, NASA Habitable Worlds.
- 2010–2013 Graduate student, Advisor/PI: Adam Showman, “The Coupled Orbital and Thermal Evolution of Io”, NASA Earth and Space Science graduate student Fellowship (NESSF).

TEACHING AND ADVISING EXPERIENCE

- 2017–Present **Research advisor**
Jet Propulsion Laboratory
- Postdocs:
2020–Present Ben Byron
- Undergraduates:
2020–Present Ashley Rincon (Palomar College)
Summers Benjamin Douglass (University of Colorado, Boulder 2022-anticipated)
2018–2020
Fall 2019 Ferdaws Rashid (Glendale Community College)
2017–2019 Jose Martinez-Camacho (Cal Poly Pomona 2019; now graduate student at Southern Methodist University)
Summer 2018 Sophie Taylor (UCLA 2020)
Summer 2017 James Haber (co-advised with Paul Hayne; Cornell University 2018; now graduate student at Purdue)
- High school:
2019–Present Sam Orientale (Briarcliff High School)

- 2008–2014
(9 semesters) **Graduate Teaching Associate**
University of Arizona
Planet Earth: Evolution of a Habitable World (Spring 2013, Fall 2013)
Golden Age of Planetary Exploration (Spring 2012)
Astrobiology: A Planetary Perspective (Fall 2011, Fall 2012, Fall 2014)
The Universe and Humanity: Origin and Destiny (Fall 2008, Spring 2009, Spring 2014)
- 2009 **Relevant Coursework**
University of Arizona
Student in ‘Teaching College-Level Astronomy and Planetary Science’.
Taught by: Gina Brissenden and Edward Prather.
- 2006–2008 **Physics Tutor**
Cornell University
Held office hours in the tutoring center, which was open to all students in three different levels of introductory physics classes.

PROFESSIONAL SERVICE

Roadmap to Ocean Worlds (ROW) team member

NASA Review Panel Group Chief, Panelist, External Reviewer, and/or Executive Secretary for the following programs: Planetary Data Archiving, Restoration, and Tools; Lunar Data Analysis Program; Mars Data Analysis Program; Discovery Data Analysis Program; New Frontiers Data Analysis Program; Solar System Workings; NASA Earth and Space Science Fellowship; PICASSO

Journal referee: *Icarus*, *Journal of Geophysical Research – Planets*, *IEEE Transactions on Geoscience and Remote Sensing*

Judge of presentations: American Geophysical Union, Outstanding Student Paper Awards; Lunar and Planetary Science Conference, Dwornik Award; JPL postdoc Research Day Poster Session

University of Arizona Graduate Student Council Travel Grant Reviewer

Graduate Student Representative to the Department of Planetary Sciences Faculty, 2011–2012

Co-Organizer of the Lunar and Planetary Laboratory Conference, 2011, 2012

PROFESSIONAL MEMBERSHIPS

Geologic Society of America

American Astronomical Society, Division of Planetary Sciences

American Geophysical Union

OUTREACH

2018	Explore JPL Europa exhibit volunteer
2018	Lunar Reconnaissance Orbiter Reddit ‘Ask Me Anything’
2014	Science Fair judge at Fruchthendler Elementary School, Tucson, AZ
2013, 2014	Volunteer at the ‘Science City’ section of the Tucson Festival of Books
2012	Volunteer at the Arizona Science and Astronomy Expo
Summer 2003	Weekly volunteer at the Boston Museum of Science

PUBLICATIONS

(Students supervised)

B. Rozitis, A. J. Ryan, J. P. Emery, P. R. Christensen, V. E. Hamilton, A. A. Simon, D. C. Reuter, M. Al Asad, R.-L. Ballouz, J. L. Bandfield, O. S. Barnouin, C. A. Bennett, M. Bernacki, K. N. Burke, S. Cambioni, B. E. Clark, M. G. Daly, M. Delbo, D. N. DellaGiustina, **C. M. Elder**, R. D. Hanna, C. W. Haberle, E. S. Howell, D. R. Golish, E. R. Jawin, H. H. Kaplan, L. F. Lim, J. L. Molaro, D. P. Munoz, M. C. Nolan, B. Rizk, M. A. Siegler, H. C. M. Susorney, K. J. Walsh, D. S. Laretta (2020) Asteroid (101955) Bennu’s weak boulders and thermally anomalous equator. *Sci. Adv.* 6, eabc3699.

Bottke, W. F., D. Vokrouhlický, R.-L. Ballouz, O. S. Barnouin, H. C. Connolly, Jr., **C. Elder**, S. Marchi, T. J. McCoy, P. Michel, M. C. Nolan, B. Rizk, D. J. Scheeres, S. R. Schwartz, K. J. Walsh, D. S. Laretta (2020) Interpreting the Cratering Histories of Bennu, Ryugu, and Other Spacecraft-explored Asteroids, *The Astronomical Journal* 160:14, 37pp.

Elder, C.M., B. Douglass, R.R. Ghent, P.O. Hayne, J.-P. Williams, J.L. Bandfield, E. Costello, (2019) The Subsurface Coherent Rock Content of the Moon as Revealed by Cold-Spot Craters. *Journal of Geophysical Research - Planets* 124, 3373-3384.

Walsh, K. J., E. R. Jawin, R.-L. Ballouz, O. S. Barnouin, E. B. Bierhaus, H. C. Connolly, J. L. Molaro, T. J. McCoy, M. Delbo, C. M. Hartzell, M. Pajola, S. R. Schwartz, D. Trang, E. Asphaug, K. J. Becker, C. B. Beddingfield, C. A. Bennett, W. F. Bottke, K. N. Burke, B. C. Clark, M. G. Daly, D. N. DellaGiustina, J. P. Dworkin, **C.M. Elder**, D. R. Golish, A. R. Hildebrand, R. Malhotra, J. Marshall, P. Michel, M. C. Nolan, M. E. Perry, B. Rizk, A. Ryan, S. A. Sandford, D. J. Scheeres, H. C. M. Susorney, F. Thuillet, D. S. Laretta & The OSIRIS-REx Team (2019) Craters, boulders and regolith of (101955) Bennu indicative of an old and dynamic surface. *Nature Geoscience* 12, 242-246.

DellaGiustina, D. N., J. P. Emery, D. R. Golish, B. Rozitis, C. A. Bennett, K. N. Burke, R.-L. Ballouz, K. J. Becker, P. R. Christensen, C. Y. Drouet d’Aubigny, V. E. Hamilton, D. C. Reuter, B. Rizk, A. A. Simon, E. Asphaug, J. L. Bandfield, O. S. Barnouin, M. A. Barucci, E. B. Bierhaus, R. P. Binzel, W. F. Bottke, N. E. Bowles, H. Campins, B. C. Clark, B. E. Clark, H. C. Connolly Jr., M. G. Daly, J. de Leon, M. Delbo, J. D. P. Deshapriya, **C.M. Elder**, S. Fornasier, C. W. Hergenrother, E. S. Howell, E. R. Jawin, H. H. Kaplan, T. R. Kareta, L. Le Corre, J.-Y. Li, J. Licandro, L. F. Lim, P. Michel, J. Molaro, M. C. Nolan, M. Pajola, M. Popescu, J. L. Rizos Garcia, A. Ryan, S. R.

Schwartz, N. Shultz, M. A. Siegler, P. H. Smith, E. Tatsumi, C. A. Thomas, K. J. Walsh, C. W. V. Wolner, X.-D. Zou, D. S. Lauretta & The OSIRIS-REx Team (2019) Properties of rubble-pile asteroid (101955) Bennu from OSIRIS-REx imaging and thermal analysis. *Nature Astronomy* 3, 341-351.

Nesnas, I. A., L. Kerber, A. Parness, R. Kornfeld, G. Sellar, P. McGarey, T. Brown, M. Paton, M. Smith, A. Johnson, M. Heverly, J. Sawoniewicz, C. Yahnker, T. Pailevanian, E. Sunada, B. Gaume, A. Curtis, **C. Elder**, K. Uckert, M. Vaquero, Y. Cheng, B. Denevi, L. Jozwiak, A. Stickle, J. Whitten, L. Keszthelyi, J. Haruyama, R. Wagner, P. Hayne, T. Horvath, J. Head, J. Hopkins, J. Ricks, E. Boster (2019) Moon Diver: A Discovery Mission Concept for Understanding the History of Secondary Crusts through the Exploration of a Lunar Mare Pit. *IEEE Aerospace Conference* pp. 1-23. 10.1109/AERO.2019.8741788

Elder, C.M., A. M. Bramson, L. W. Blum, H. T. Chilton, A. Chopra, C. Chu, A. Das, A. Davis, A. Delgado, J. Fulton, L. Jozwiak, A. Khayat, M. Landis, J. L. Molaro, M. Slipski, S. Valencia, J. Watkins, C. Young, C. J. Budney, K. L. Mitchell (2018) OCEANUS: A high science return Uranus orbiter with a low-cost instrument suite. *Acta Astronautica* 148, 1-11.

Hayne, P. O., J. L. Bandfield, M. A. Siegler, A. R. Vasavada, R. R. Ghent, J.-P. Williams, B. T. Greenhagen, O. Aharonson, **C.M. Elder**, P. G. Lucey, D. A. Paige (2017) Global Regolith Properties of the Moon from the Diviner Lunar Radiometer Experiment. *Journal of Geophysical Research - Planets* 122, 2371-2400.

Elder, C.M., P. O. Hayne, J. L. Bandfield, R. R. Ghent, J.-P. Williams, K. L. Donaldson Hanna, D. A. Paige (2017) Young Lunar Volcanic Features: Thermophysical Properties and Formation. *Icarus* 290, 224-237.

Elder, C.M., V. J. Bray, H. J. Melosh (2012) The Theoretical Plausibility of Central Pit Crater Formation Via Melt Drainage. *Icarus* 221, 831-843.

CONFERENCE PRESENTATIONS

(Students supervised)

2021

Elder C. M., B. Douglass, R.R. Ghent, P.O. Hayne, J.-P. Williams, E. Costello (2021) The Subsurface Coherent Rock Content of the Moon as Revealed by Cold-Spot Craters. Lunar and Planetary Science Conference, #52, abstract #1725.

Douglass, B. and **C.M. Elder** (2021) Constraining the Thickness of the Lunar REgolith Using Cold-Spot Craters. Lunar and Planetary Science Conference, #52, abstract #2668.

Trang, D., T. Tonkham, S. Li, L. M. Jozwiak, and **C. M. Elder** (2021) The Relationship Between Water Abundance and the Physical and Compositional Properties of Lunar Localized Pyroclastic Deposits. Lunar and Planetary Science Conference, #52, abstract #1698.

Elder, C.M., T. Nordheim, D.A. Patthoff, E. Leonard, R. Cartwright, C. Cochrane, C. Paranicas, M. Tiscareno, A. Masters, D. Hemingway, M. Sori, H. Cao, R. Pappalardo, B. Buratti, I. De Pater, W. Grundy, M. Showalter, B. Kurth, I. Jun, J. Moses, K. Aplin, J. Casani (2021) Uranus Magnetosphere and Moons Investigator (UMaMI). Lunar and Planetary Science Conference, #52, abstract #2289.

Cochrane, C.J., T.A.Nordheim, S.D. Vance, M.Styczinski, K.Soderlund, **C. M. Elder**, E. J. Leonard, R. J. Cartwright, C. B. Beddingfield, L.H. Regoli, N. Gomez-Perez (2021) In Search of Subsurface Oceans within the Moons of Uranus. Lunar and Planetary Science Conference, #52, abstract #1559.

Cartwright, R. J. , T. A. Nordheim, W. M. Grundy, D. DeColibus, M. M. Sori, C. B. Beddingfield, E. J. Leonard, **C. M. Elder**, C. J. Cochrane, L. H. Regoli, D. H. Atkinson, B. J. Holler, D. P. Cruikshank, J. P. Emery (2021) Latitudinal Distribution of CO₂ Ice on Ariel Consistent with Seasonal Migration. Lunar and Planetary Science Conference, #52, abstract #1298.

Leonard, E. J., C. Beddingfield, **C. M. Elder**, T. A. Nordheim, R. J. Cartwright, C.Cochrane, and L.Regoli (2021) Investigating the Formation of Miranda's Inverness Corona. Lunar and Planetary Science Conference, #52, abstract #2296.

Beddingfield, C. B., E. J. Leonard, **C. M. Elder**, T. A. Nordheim, R. J. Cartwright, C. Cochrane, L. Regoli, and D. Atkinson (2021) A Digital Elevation Model of Miranda's Youngest Corona, Inverness. Lunar and Planetary Science Conference, #52, abstract #2543.

Scully, J. E. C., Cerretti, A. Viswanathan, J. K. Steckloff, C. Richey, A. Probst, G. Poh, M. Melwani Daswani, C. L. McLeod, X. Mao, R. Lillis, N. Kumari, H. Kraus, T. Hoogenboom, H. Hay, T. A. Goudge, E. C. Fayolle, **C. M. Elder**, S. Diniega, S. Daftry, P. K. Byrne, S. M. Brooks, J. G. Blank, P. Becerra, S. Bandyopadhyay (2021) Foreign Nationals Employed and Studying in Planetary Research in the United States, and Recommendations for Supporting this Group. Lunar and Planetary Science Conference, #52, abstract #1493.

S. D. Vance, **C. Elder**, A. Hofmann, S. Howell, M. Milazzo, R. T. Pappalardo, J.L.Noviello, D. A. Patthoff, Z. Khan, J. Rathbun, J. Vertesi and co-signers of the associated 2023 Planetary Science Decadal White Paper (2021) Addressing Mental Health in Planetary Science. Lunar and Planetary Science Conference, #52, abstract #2552.

2020

Rozitis, B., AJ Ryan, JP Emery, PR Christensen, VE Hamilton, AA Simon, DC Reuter, M Al Asad, RL Ballouz, JL Bandfield, OS Barnouin, CA Bennett, M Bernacki, KN Burke, S Cambioni, BE Clark, MG Daly, M Delbo, DN DellaGiustina, **CM Elder**, RD Hanna, CW Haberle, ES Howell, D Golish, ER Jawin, HH Kaplan, LF Lim, JL Molaro, D Pino Munoz, MC Nolan, B Rizk, MA Siegler, HCM Susorney, KJ Walsh, DS Lauretta (2020) Thermophysical Properties of Bennu and the OSIRIS-REx Sample Sites. AAS Division for Planetary Sciences Meeting 52, Abstract #400.06.

Rathbun, J., **C Elder**, J Keane, C Richey, R Watkins, N Zellner (2021) Enabling the Planetary Workforce to Do the Best Science by Funding Work That is a Service to the Profession. AAS Division for Planetary Sciences Meeting 52, Abstract #502.03.

Elder C. M., B. Douglass, R.R. Ghent, P.O. Hayne, J.-P. Williams, E. Costello (2020) The Subsurface Coherent Rock Content of the Moon as Revealed by Cold-Spot Craters. Lunar and Planetary Science Conference, #51, abstract #1167.*

Pajola, M., B.Rizk, E.R. Jawin, K.J.Walsh, D.N. DellaGiustina, H.Campins, J.L. Molaro, M. Delbo, T.J. McCoy, S.R. Schwartz, R. Ballouz, G. Poggiali, J.R. Brucato, E. Dotto, E.B. Bierhaus, K. Burke, C.A. Bennett, M.G. Daly, **C. Elder**, P. Michel, O.S. Barnouin, M.C. Nolan, and D.S. Lauretta (2020) Surface Density and Size Distribution of Clasts on (101955) Bennu's Boulders: Exposed Clasts or Fallback Material? Lunar and Planetary Science Conference, #51, abstract #1400.*

Kerber, L., B.W. Denevi, I. Nenas, L. Keszthelyi, J.W. Head, C. Pieters, L. Wilson, J. Haruyama, R.V. Wagner, P.O. Hayne, J.W. Ashley, J.L. Whitten, A.M. Stickle, A. Parness, K. Donaldson Hanna, R.C. Anderson, D.M. Needham, P. Isaacson, L. Jozwiak, R. Klima, C. Jackson, T.C. Prissel, C.W. Hamilton, K. Uckert, **C. Elder**, and A. Colaprete (2020) Moon Diver: Journey into the Ancient Lavas of the Moon. Lunar and Planetary Science Conference, #51, abstract #1857.*

Diniega, S., Julie Castillo-Rogez, Ingrid Daubar, **Catherine Elder**, Robert Pappalardo, Christina Richey, Jennifer Scully, Mickey Villarreal (2020) Why and How to Write a Useful "Code of Conduct" for Planetary Conferences and Mission Teams. Lunar and Planetary Science Conference, #51, abstract #2482.*

Elder, C.M., T. Nordheim, D.A. Patthoff, E. Leonard, R. Cartwright, C. Cochrane, C. Paranicas, M. Tiscareno, A. Masters, D. Hemingway, M. Sori, H. Cao, R. Pappalardo, B. Buratti, I. De Pater, W. Grundy, M. Showalter, B. Kurth, I. Jun, J. Moses, K. Aplin, J. Casani (2020) Uranus Magnetosphere and Moons Investigator (UMaMI). Lunar and Planetary Science Conference, #51, abstract #2277.*

Roberts, J.H. A.M. Rymer, M.L. Cable, F. Nimmo, C.S. Paty, M.T. Bland, **C.M. Elder**, H. Korth, T.B. McCord, W.B. McKinnon, R.T. Pappalardo, C.A. Raymond, L. Roth, J. Saur, D.M. Schroeder, G. Steinbrugge, K.M. Soderlund, G. Tobie, S.D. Vance, D.A. Young, D.A. Senske, and the Europa Clipper Interior Thematic Working Group (2020) Integrated Europa Interior Science with Europa Clipper. Lunar and Planetary Science Conference, #51, abstract #2281.*

*Note the Lunar and Planetary Science Conference, #51 was canceled due to concerns regarding the COVID-19 outbreak. Abstracts included here were accepted and scheduled for oral or poster presentations but not presented.

2019

Pajola, M. B. Bierhaus, K.J. Walsh, D.N. DellaGiustina, E.R. Jawin, M. Delbo, J. Molaro, S.R. Schwartz, R.-L Ballouz, C.A. Bennett, B. Rizk, K.N. Burke, H. Campins, J.R. Brucato, G. Poggiali, E. Dotto, M.G. Daly, **C.M. Elder**, P.Michel, M.E. Perry, O.S.

Barnouin, M.C. Nolan and D.S. Lauretta (2019) Surface densities and size-frequency distributions of meter-size boulders inside craters on (101955) Bennu. American Geophysical Union Fall Meeting.

Ryan, A.J., D. Pino-Munoz, J.P. Emery, M. Delbo, B. Rozitis, R.-L. Ballouz, J.L. Molaro, M. Bernacki, J. Bandfield, **C. Elder**, M. Siegler, and D.S. Lauretta (2019) Thermal Modeling to Determine the Existence and Nature of Layered Material on Bennu. Asteroid Science in the Age of Hayabusa2 and OSIRIS-REx, abstract #2189.

Bottke, W.F., D. Vokrouhlicky, R.-L. Ballouz, O.S. Barnouin, H.C. Connolly Jr., **C. Elder**, T.J. McCoy, P. Michel, M.C. Nolan, B. Rizk, D.J. Scheeres, S.R. Schwartz, K.J. Walsh, D.S. Lauretta (2019) Interpreting the Cratering History of Bennu, Ryugu, and Other Space-Craft Explored Asteroids. Asteroid Science in the Age of Hayabusa2 and OSIRIS-REx, abstract #2189.

Elder, C.M., B. Douglass, R.R. Ghent, P.O. Hayne, J.-P. Williams, J.L. Bandfield, E. Costello (2019) The Subsurface Coherent Rock Content of the Moon as Revealed by Cold-spot Craters. Geologic Society of America Annual Meeting T93 13-10 (invited).

Bottke W., D. Vokrouhlicky, R. Ballouz, O. Barnouin, H. Connolly, **C. Elder**, D. Lauretta, T. McCoy, P. Michel, M. Nolan, B. Rizk, D. Scheeres, S. Schwartz, and K. Walsh (2019) Interpreting the Cratering History of Bennu, Ryugu, and Other Spacecraft-Explored Asteroids. European Planetary Science Congress-Division of Planetary Science Joint Meeting abstract #862

Ryan, A., J. Emery, B. Rozitis, P. Christensen, V. Hamilton, M. Delbo, D.P. Munoz, M. Bernacki, K. Walsh, R. Ballouz, B. Clark, D. DellaGiustina, **C. Elder**, E. Howell, L. Lim, J. Molaro, M. Nolan, B. Rizk, S. Schwartz, M. Siegler and the OSIRIS-REx Team (2019) Physical Interpretation of Bennu's Thermal Inertia. European Planetary Science Congress-Division of Planetary Science Joint Meeting abstract #324.

Maurizio P., E. Bierhaus, K. Walsh, D. DellaGiustina, E. Jawin, M. Delbo, J. Molaro, S. Schwartz, R. Ballouz, C. Bennett, B. Rizk, K. Burke, H. Campins, J.R. Brucato, E. Dotto, M. Daly, **C.M. Elder**, P. Michel, M. Perry, O. Barnouin and the OSIRIS-REx Team (2019) Boulders inside the craters of asteroid (101955) Bennu: Surface densities and size-frequency distributions. European Planetary Science Congress-Division of Planetary Science Joint Meeting abstract #187.

L. Kerber, B.W. Denevi, I. Nesnas, L. Keszthelyi, J.W. Head, C. Pieters, L. Wilson, J. Haruyama, R.V. Wagner, P.O. Hayne, J.W. Ashley, J.L. Whitten, A.M. Stickle, A. Parness, K. Donaldson Hanna, R.C. Anderson, D.M. Needham, P. Isaacson, L. Jozwiak, R. Klima, C. Jackson, T.C. Prissel, C.W. Hamilton, K. Uckert, **C. Elder** (2019) Moon Diver: A Discovery Mission Concept for Understanding Secondary Crust Formation Through the Exploration of a Lunar Mare Pit Cross-Section. European Lunar Symposium.

Elder, CM, B Douglass, PO Hayne, RR Ghent, J-P Williams, JL Bandfield, E Costello (2019) Mapping Regolith Thickness on the Moon Using a New Class of Young Craters. Lunar and Planetary Science Conference, #50, abstract #2485.

Klimczak, C., P.K. Byrne, P.V. Regensburger, D.R. Bohnenstiehl, S.A. Hauck, A.J. Dombard, D.J. Hemingway, S.D. Vance, D.M. Melwani, **C.M. Elder** (2019) Strong Ocean Floors Within Europa, Titan, and Ganymede Limit Geological Activity There; Enceladus Less So. Lunar and Planetary Science Conference, #50, abstract #2912.

L. Kerber, B.W. Denevi, I. Nefzger, L. Keszthelyi, J.W. Head, C. Pieters, L. Wilson, J. Haruyama, R.V. Wagner, P.O. Hayne, J.W. Ashley, J.L. Whitten, A.M. Stickle, A. Parness, K. Donaldson Hanna, R.C. Anderson, D.M. Needham, P. Isaacson, L. Jozwiak, R. Klima, C. Jackson, T.C. Prissel, C.W. Hamilton, K. Uckert, **C. Elder** (2019) Moon Diver: A Discovery Mission Concept for Understanding Secondary Crust Formation Through the Exploration of a Lunar Mare Pit Cross-Section. Lunar and Planetary Science Conference, #50, abstract #1163

M Pajola, K Burke, D DellaGiustina, D Lauretta, B Rizk, C Bennett, K Walsh, E Jawin, M Delbo, JL Molaro, SR Schwartz, R Ballouz, JR Brucato, E Dotto, EB Bierhaus, H Campins, M Daly, **C Elder**, P Michel, O Barnouin, MC Nolan (2019) Global and Select Regional Size-Frequency Distribution of Boulders on Asteroid (101955) Bennu. Lunar and Planetary Science Conference, #50, abstract #1575.

Molaro, J.L., M. Delbo, R.-L. Ballouz, E. Jawin, K. Walsh, M. Pajola, T. McCoy, S. Schwartz, **C.M. Elder**, D. DellaGiustina, B. Rizk, C. d'Aubigny, D.S. Lauretta, OSIRIS-REx Team (2019) Fracture Formation Mechanisms on Bennu and Evidence of Thermally Driven Breakdown. Lunar and Planetary Science Conference, #50, abstract #1597.

Emery, JP, B Rozitis, PR Christensen, VE Hamilton, AA Simon, DC Reuter, M Delbo, LF Lim, CA Thomas, BE Clark, A Ryan, **CM Elder**, MA Siegler, ES Howell, MC Nolan, DS Lauretta, Osiris-Rex Team (2019) Thermophysical Properties of (101955) Bennu from OSIRIS-REx Observations. Lunar and Planetary Science Conference, #50, abstract #2582.

Pajola, M., D. DellaGiustina, C. Bennett, K. Burke, D. S. Lauretta, B. Rizk, M. Delbo, K. Walsh, J. R. Brucato, E. Dotto, E. B. Bierhaus, H. Campins, M. Daly, **C.M. Elder**, P. Michel, J. Molaro, M. C. Nolan, S. R. Schwartz & The OSIRIS-REx Team (2019) Scientific Analysis of the Size-Frequency Distribution of Boulders ≥ 10 m on Asteroid (101955) Bennu. Italian Congress of Planetology XV.

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