

# LINDA TARBOX ELKINS-TANTON

Curriculum Vitae

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Arizona State University Vice President for the Interplanetary Initiative

Principal Investigator, NASA Psyche mission

Co-founder, Beagle Learning

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## RESEARCH

Terrestrial planetary formation and subsequent planetary evolution. Creation of effective interdisciplinary teams and their leadership for maximizing discovery. Inquiry and exploration learning and the reformation of education for the Information Age.

### Research Achievements

- The evolution of planetesimals includes partially differentiated and other complex compositional structures, explaining physical and compositional observations from meteorites and asteroids.
- The Siberian flood basalts caused the end-Permian extinction: The flood basalts erupted most of their volume before the end-Permian extinction occurred; the magmatism released carbon, sulfur, and halocarbons sufficient to drive catastrophic global climate change; the flood basalts began with a world-record volume of volcaniclastics, many erupted as tuffs and burning a significant coal volume.
- Rocky planets are born habitable: Magma ocean stages of terrestrial planet formation retained sufficient water to create habitable planets without additional water delivery (though that is inevitable as well), and the silicate differentiation produced by magma ocean solidification creates successful predictions about current-day Moon, Earth, Mercury, and Mars.
- Drip magmatism: Lithospheric gravitational instabilities heat, melt, and produce magmatism while they sink into the mantle; verified in Chile, in Tibet, in the Sierra Nevada, and in east Africa.
- The productivity of research questions can be rated using a rubric and scored successfully by artificial intelligence.

### Leadership Achievements

- Led the Psyche mission team in NASA competition with 27 other mission proposals resulting in selection for flight, and now responsible for the ~\$800M budget. Tied together ~6 major organizations and a dozen subcontractors to produce the spacecraft; united the science and engineering teams.
- Brought the ASU School of Earth and Space Exploration to #1 in the NSF HERD rankings in our discipline, with >\$65M/year in research expenditures. Maintaining positive culture was a high priority in this group of ~60 faculty with ~350 people on payroll. Between 2014 and 2019, raised the percentage of women faculty from ~10 to ~30%.
- Conceived of and created with ASU President Michael Crow the ASU Interplanetary Initiative, a pan-university effort to create the research and education necessary for a human interplanetary future. Our process for building interdisciplinary teams has produced an 8x return in the form of external grants and gifts following our seed funding.

## EDUCATION

PhD, Geology and Geophysics, MIT, 2002. Advisors: Timothy L. Grove and Bradford H. Hager.

MS, Geochemistry, MIT, 1987. Advisor: Timothy L. Grove.

BS, Geology, MIT, 1987.

## EMPLOYMENT

### Present: Arizona State University, NASA Psyche mission, and Beagle Learning

Principal Investigator, [NASA Psyche mission](#), 2011 (work began) – 2017 (flight selection) – present

ASU Vice President and Co-Chair of the [Interplanetary Initiative](#), 2021 – present

Regents Professor for the State of Arizona, 2021–present

ASU University Professor, 2021 – present

Co-Founder, [Beagle Learning](#), 2015 – present

Managing Director and Co-Chair, Interplanetary Initiative, ASU, 2017 – 2020

Foundation Professor, School of Earth and Space Exploration, 2014 – 2020

Director, School of Earth and Space Exploration, Arizona State University, 2014 – 2019

### Carnegie Institution for Science

Director, Dept. of Terrestrial Magnetism, Carnegie Institution for Science, 2011 – 2014

### MIT

Mitsui Assistant Professor of Geology, MIT, 2008 – 2011

Assistant Professor of Geology, MIT, 2007 – 2008

### Previous

Research Associate and Senior Research Associate, Brown University, 2002 – 2007

PhD candidate, MIT, 1997 – 2002

Lecturer in Mathematics, St. Mary's College of Maryland, 1995 – 1997

Principal, Business Plan Writing, Annapolis, MD, 1990 – 1995

Circulation Analyst, US News & World Report, Washington DC, 1989 – 1990

Interim Publisher, International Wine Review Magazine, Ithaca, NY, 1988 – 1989

Research Associate, Touche Ross & Co., Philadelphia, PA, 1987 – 1988

## PEER-REVIEWED PUBLICATIONS (INCLUDING BOOK CHAPTERS AND REVIEWED ENGINEERING CONFERENCE PAPERS)

List available on [Google citations](#). In bold: Students and postdocs for whom I was primary or secondary advisor on the specific published project.

Submitted

2022

133. **Carver J. Bierson**, L. T. Elkins-Tanton, J.G. O'Rourke, The geologic impact of 16 Psyche's surface temperatures, *Planetary Science Journal*, accepted.

132. **Samuel W. Courville**, Joseph G. O'Rourke, Julie C. Castillo-Rogez, Roger R. Fu, Rona Oran, Benjamin P. Weiss, Linda T. Elkins-Tanton, Magnetization of carbonaceous asteroids by nebular fields and the origin of magnetized chondrites, *Nature Astronomy*, accepted.

131. Oran, R. B.P. Weiss, M. De Soria Santacruz-Pic, I. Jun, D J. Lawrence, C.A. Polanskey, J.M. Ratli, C.A. Raymond, J.B. Ream, C.T. Russell, Y.Y. Shprits, M.T. Zuber, L.T. Elkins-Tanton, Maximum energies of trapped particles around magnetized planets and small bodies, *Geophysical Research Letters* 49, e2021GL097014, 2022.

130. Timothy J McCoy, SD Dibb, PN Peplowski, C Maurel, **HL Bercovici**, CM Corrigan, JF Bell, BP Weiss, DJ Lawrence, DD Wenkert, TH Prettyman, LT Elkins-Tanton, Deciphering Redox State for a Metal-Rich World, *Space Science Reviews* 218(2) 1-28, 2022.

129. L.T. Elkins-Tanton, E. Asphaug, J. F. Bell III, **C. J. Bierson**, B. G. Bills, W. F. Bottke, **S. Courville**, **S. Dibb**, I. Jun, D. J. Lawrence, S. Marchi, T. J. McCoy, J. Merayo, R. Oran, J. G. O'Rourke, R. S. Park, P. N. Peplowski,

- T. H. Prettyman, C. A. Raymond, B. P. Weiss, M. A. Wieczorek, M. T. Zuber, Distinguishing the origin of asteroid (16) Psyche, *Space Science Reviews*, 2022, 218:17, doi.org/10.1007/s11214-022-00880-9.
128. **H. Bercovici**, L.T. Elkins-Tanton, J.G. O'Rourke, L. Schaefer, The effects of bulk composition on planetesimals core sulfur content and size, *Icarus* 180, doi.org/10.1016/j.icarus.2022.114976, 2022.
127. M.T. Zuber, R.S. Park, L.T. Elkins-Tanton, J. Bell, C.A. Polanskey, D. Bercovici, B.R. Bills, R.P. Binzel, R. Jaumann, S. Marchi, C.A. Raymond, T. Roatsch, B.P. Weiss, and M.A. Wieczorek, The Psyche gravity investigation, *Space Science Reviews*, 2022, accepted.
126. **Christoph, J.**, C. Bu, G. Minesinger, C. Dukes, L.T. Elkins-Tanton, Space weathering effects in troilite by simulated solar-wind hydrogen and helium ion irradiation, *Journal of Geophysical Research*, 2022, accepted.
- 2021
125. Bohlen, T., L. Elkins-Tanton, C. Bickers, and J. Tanton, Make It Matter: A collaborative student-led engagement and persistence program, In D. Guralnick, M.E. Auer, A. Poce, Eds., *Innovations in Learning and Technology for the Workplace and Higher Education, Proceedings of 'The Learning Ideas Conference'* Springer, Cham, Switzerland, pp 40-48, 2021.
124. Ream, J.; Weiss, B.; Oran, R.; Raymond, C.; Polanskey, C.; Wenkert, D.; Elkins-Tanton, L.; Hart, R.; Russell, C., Magnetic Gradiometry Using Frequency-Domain Filtering, *Measurement Science and Technology* 33(1) 015104, 2021.
123. Lawrence, D.L., J.O. Goldsten, P.N. Peplowski, Z.W. Yokley, A.W. Beck, M. Burks, L.T. Elkins-Tanton, I. Jun, T. McCoy, T.H. Prettyman, Planetary Neutron Spectroscopy for Metal-rich Compositions: Development of Analysis Framework for Measurements at the Asteroid (16) Psyche, in revision 2021.
122. Elkins-Tanton, L.T., The “Frozen, Darkened Soul” rises into space: Travels in Siberia and the plight of life on Earth, *Leonardo (Journal of the International Society for the Arts, Sciences and Technology)* 54(1), 49-55, 2021.
121. Maurel, C., J.F.J. Bryson, J. Shah, R. V. Chopdekar, L. T. Elkins-Tanton, C. A. Raymond, B. P. Weiss, A long-lived planetesimal dynamo powered by core crystallization, *Geophysical Research Letters* 48, https://doi.org/10.1029/2020GL091917, 2021.
120. Ortega, C., C. Polanskey, M. Llopis, P. Rosemurgy, C. Lawler, E.K. Alonge, M. Dailis, and L. Elkins-Tanton, Psyche Science Planning with the Science Opportunity Analyzer, 16<sup>th</sup> International Conference on Space Operations, The International Committee on Technical Interchange for Space Mission Operations and Ground Data Systems, International Aeronautical Federation, 2021.
119. Elkins-Tanton, L.T., S.E. Grasby, B.A. Black, R.V. Veselovskiy, O.H. Ardakani, F. Goodarzi, Reply to the comment by Davydov et al. on “Field evidence for coal combustion links the 252 My-old Siberian Traps with global carbon disruption,” *Geology* 48(10), 986-991, 2021.
- 2020
118. Elkins-Tanton, L.T., E. Shkolnik, M.C. Crow, The Arizona State University Interplanetary Initiative: Envisioning and Creating Our Human Space Future, *New Space*, https://doi.org/10.1089/space.2020.0036, 2020.
117. Elkins-Tanton, L.T., S.E. Grasby, B.A. Black, R.V. Veselovskiy, O.H. Ardakani, F. Goodarzi, Field evidence for coal combustion links the 252 My-old Siberian Traps with global carbon disruption, *Geology* v48(1), v. 48(10), 986–991, 2020.
116. Elkins-Tanton, L.T., E. Asphaug, J.F. Bell III, H. Bercovici, B.Bills,R. Binzel, W.F. Bottke, **S. Dibb**, D.J. Lawrence, S. Marchi, T.J. McCoy, R. Oran, R.S. Park, P.N. Peplowski, C.A. Polanskey, T.H. Prettyman, C.T. Russell, **L. Schaefer**, B.P. Weiss, M.A. Wieczorek, D.A. Williams, M.T. Zuber, Observations, meteorites, and models: A pre-flight assessment of the composition and formation of (16) Psyche, *Journal of Geophysical Research: Planets*, 10.1029/2019JE006296, 2020.
115. Becker, T.M., N. Cunningham, P. Molyneux, L. Feaga, K.D. Retherford, R. Lotenz, Z.A. Landsman, E. Peavler, L.T. Elkins-Tanton, J.-E. Walhund, HST UV Observations of Asteroid (16) Psyche, *The Planetary Journal*, 1 (3), 53, 2020.
114. de Soria-Santacruz, M., M. Soriano, O. Quintero, F. Wong, S. Hart, M. Kokorowski, B. Bone, B. Solish, D. Trofimov, E. Bradford, C. Raymond, P. Narvaez, C. Keys, P. Lord, J. Ream, R. Oran, B.P. Weiss, C. Russell, K.

- Ascrizzi, L. Elkins-Tanton, An approach to magnetic cleanliness for the Psyche mission, IEEE Aerospace Conference Proceedings, 1-15, 2020.
113. Gales, E., B. Black, L.T. Elkins-Tanton, Carbonatites as a record of the carbon isotope composition of large igneous province outgassing, *Earth and Planetary Science Letters* 535, 2020.
112. Marchi, S., D.D. Durda, C.A. Polanskey, E. Asphaug, W.F. Bottke, L.T. Elkins-Tanton, L. A. J. Garvie, S. Ray, S. Chocron, and D.A. Williams, Hypervelocity impact experiments in iron-nickel ingots and meteorites: Implications for the NASA Psyche mission. *Journal for Geophysical Research*, 10.1029/2019JE005927, 2020.
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111. Oh, D., S. Collins, T. Drain, W. Hart, T. Imken, K. Larson, D. Marsh, D. Muthulingam, J.S. Snyder, D. Trifomov, L.T. Elkins-Tanton, I. Johnson, P. Lord, Z. Pirl, Development of the Psyche mission for NASA's Discovery Program, IEPC-2019-192, 2019.
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108. Wang Y., Bohlen T., Elkins-Tanton L., Tanton J., Motivating Students to Ask More Questions. In: Isotani S., Millán E., Ogan A., Hastings P., McLaren B., Luckin R. (eds) Artificial Intelligence in Education. AIED 2019. Lecture Notes in Computer Science, vol 11626. Springer. [https://doi.org/10.1007/978-3-030-23207-8\\_75](https://doi.org/10.1007/978-3-030-23207-8_75), 2019.
107. Hart W., S. Boland, T. Drain, P. Lai, K. Lum, D.Y. Oh, B. Solish, S. Snyder, N. Warner, A. Williams, P. Lord, L. Elkins-Tanton, Requirements Development and Management on the Psyche Project, IEEE Aerospace, 2019.
- 2018
106. Polanskey C.A., L. Elkins-Tanton, R. Jaumann, D. J. Lawrence, D. M. Marsh, R. R. Moore, R. S. Park, M. de Soria-Santacruz Pic, C. T. Russell, D. Wenkert, D. A. Williams, Psyche Science Operations: Maximize Reuse to Minimize Risk, American Institute of Aeronautics and Astronautics, Published Online 25 May 2018 <https://doi.org/10.2514/6.2018-2703>
105. Bowman, C.D.D., L.T. Elkins-Tanton, D. Bacalzo, D. Briggs, Y. Chen, P. Howell, D. McCarville, R. Meuth, E. J. Montgomery, A. Sanft and M. Zhao, Coordinating Opportunistic Interdisciplinary Projects Across Single-Discipline Capstone Courses, International Journal of Engineering Education, Proceedings of the 2018 Capstone Design Conference, 1-4, 2018.
104. Wu, J., S.J. Desch, **L. Schaefer**, L.T. Elkins-Tanton, **K. Pahlevan**, P.R. Buseck, Origin of Earth's water: chondritic inheritance plus nebular ingassing and storage of hydrogen in the core, *Journal of Geophysical Research, Planets*, 123 (10), 2691-2712, <https://doi.org/10.1029/2018JE005698>, 2018.
103. Black, B.A., R.R. Neely, J.-F. Lamarque, L. Elkins-Tanton, J.T. Kiehl, C.A. Shields, M. Mills, C. Bardeen, Systemic swings in end-Permian climate from Siberian Traps carbon and sulfur outgassing, *Nature Geoscience* 11, 949-954, 2018.
102. **Schaefer, L.** and L. T. Elkins-Tanton, Magma oceans as a critical stage in the tectonic development of rocky planets, *Philosophical Transactions of the Royal Society A* 376: 20180109, 2018.
101. Ikoma, M., L. Elkins-Tanton, K. Hamano, J. Suckale, Water partitioning in planetary embryos and protoplanets with magma oceans, *Space Science Reviews* 214, 76, 2018.
100. **Scheinberg, A.**, K. Soderlund, L. T Elkins-Tanton, A basal magma ocean dynamo to explain the early lunar magnetic field, *Earth and Planetary Science Letters* 492, 144-151, 2018.
99. Perera, V., A. Jackson, L.T. Elkins-Tanton, E. Asphaug, Effect of Re-impacting Debris on the Solidification of the Lunar Magma Ocean, *Journal of Geophysical Research*, 123 (5) 1168-1191, 2018.
98. Clark, B. E., M.A. Barucci, X.-D. Zou, M. Fulchignoni, A. Rivkin, C. Raymond, M. Yoshikawa, L. Elkins-Tanton, and H. Levison, Chapter 1: A brief history of spacecraft missions to asteroids and protoplanets, In Abrey, N. editor, *Meteorites and Asteroids*, Elsevier press, 2018.

97. Oh, D.Y, S. Collins, D. Goebel, B. Hart, G. Lantoine, S. Snyder, G. Whiffen, L. Elkins-Tanton, P. Lord, L. Rotlisburger. Development of the Psyche Mission for NASA's Discover Program, 35<sup>th</sup> International Electric Propulsion Conference, 2018.
96. Hart, W., G. Mark Brown, S. M. Collins, M. De Soria-Santacruz Pich, P. Fieseler, D. Goebel, D. Marsh, D. Y. Oh, S. Snyder, N. Warner, G. Whiffen, L. Elkins-Tanton, J. F. <sup>Bell</sup> III, D. J. Lawrence, P. Lord, Z. Pirkl, Overview of the spacecraft design for the Psyche mission concept, IEEE Aerospace, 2018.
95. Morbidelli A., M. Wieczorek, D. Nesvorny, V. Laurenz, S. Marchi, D. Rubie, L. T. Elkins-Tanton, S. Jacobsen, The timeline of the lunar bombardment - revisited, Icarus 305, 262-276, 2018.
- 2017
94. Saxena, P., L. T. Elkins-Tanton, N. Petro, A. Mandell, A model of the primordial lunar atmosphere, Earth and Planetary Science Letters 474, 198-205, 2017.
93. Lord, P., Tilley, S., Oh, D. Y., Goebel, D., Polanskey, C., Snyder, S., ... & Elkins-Tanton, L., Psyche: Journey to a metal world. In *2017 IEEE Aerospace Conference*, 1-11, 2017.
92. **Tikoo, S.** and L.T. Elkins-Tanton, The fate of water within Earth and super-Earths and implications for plate tectonics, Philosophical Transactions of the Royal Society A 375: 20150394, 2017.
91. **Blackburn, T.**, C. M O'D. Alexander, R. Carlson, L.T. Elkins-Tanton, The accretion and impact history of the ordinary chondrite parent bodies, Geochimica et Cosmochimica Acta 200, 201-217, 2017.
90. Tian, ZhenLiang , J. Wisdom, L. Elkins-Tanton, Coupled orbital-thermal evolution of the early Earth-Moon system with a fast-spinning Earth, Icarus 281, 90-102, 2017.
- 2016
89. Ehlmann, Andrews-Hanna, Carter, Catling, Christiansen, Cohen, Dressing, Edwards, Elkins-Tanton, Farley, Fassett, Fischer, Fraeman, Golombek, Grotzinger, Hamilton, Hayes, Herd, Horgan, Hu, Jakosky, J. Johnson, Kasting, Kerber, Kite, Knutson, Lunine, Mahaffey, Mangold, McCubbin, Mustard, Niles, Quantin, Rice, Stack Morgan, Stevenson, Stewart, Toplis, Usui, Weiss, Werner, Wordsworth, Wray, Yingst, Yung, Zahnle, The Sustainability of Habitability on Terrestrial Planets: Insights, Questions, and Needed Measurements from Mars for Understanding the Evolution of Earth-like Worlds, Journal of Geophysical Research 121, 1927-1961, 2016.
88. Oh, D., Goebel, D., Polanskey, C., Snyder, S., Carr, G., Collins, S., Lantoine, G., Landau, D., Elkins-Tanton, L., Lord, P., Tilley, S., Psyche: Journey to a Metal World, AIAA-2016-4541, 52<sup>nd</sup> AIAA/ASME/SAE/ASEE Joint Propulsion Conference, Salt Lake City, UT, July 25-27, 2016. (Full research paper published in engineering conference proceedings.)
87. Furman, T., W.R. Nelson, L.T. Elkins-Tanton, Evolution of the East African Rift: Drip Magmatism, Lithospheric Thinning and Mafic Volcanism, Geochimica et Cosmochimica Acta 185, 418-434, 2016.
86. Lichtenegger, H.I.M., K.G. Kislyakova, P. Odert, N.V. Erkaev, H. Lammer, H. Gröller, C.P. Johnstone, L. Elkins-Tanton, L. Tu, M. Güdel, M. Holmström, Solar XUV and ENA-driven water loss from early Venus' magma ocean outgassed steam atmosphere, Journal of Geophysical Research Space Physics 121, 4718-4732, 2016.
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81. **Scheinberg, A.**, L.T. Elkins-Tanton, G. Schubert, D. Bercovici, Core solidification and dynamo evolution in a mantle-stripped planetesimal, Journal of Geophysical Research 121, 2-20, 2016.

2015

80. **Black, B.A.**, B.P. Weiss, L.T. Elkins-Tanton, R.V. Veselovskiy, A. Latyshev, Siberian Traps volcaniclastic rocks and the role of magma-water interactions, Geological Society of America Bulletin 127, 1437-1452, 2015.
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77. Udstins Peate, I. and L.T. Elkins-Tanton, Large igneous provinces and explosive basaltic volcanism, In Volcanism and Global Environmental Change, Ed. A. Schmidt, K. Fristad, L. Elkins-Tanton, Cambridge University Press, 2015.
76. **Black, B.**, J.-F. Lamarque, C. Shields, L. T. Elkins-Tanton, J. Kiehl, Environmental effects of large igneous province magmatism: A Siberian perspective, In Volcanism and Global Environmental Change, Ed. A. Schmidt, K. Fristad, L. Elkins-Tanton, Cambridge University Press, 2015.

2014

75. **Piskorz, D.**, L. T. Elkins-Tanton, S. Smrekar, Coronae formation on Venus via extension and lithospheric instability, Journal of Geophysical Research, Planets, 119, 2568-2582, 2014.
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- 2011
51. **Suckale, J.**, B. H. Hager, L. T. Elkins-Tanton, and J. Nave, Reply to the comment by Mike R. James et al. on “It takes three to tango: 2. Bubble dynamics in basaltic volcanoes and ramifications for modeling normal Strombolian activity”, *Journal of Geophysical Research.*, 116, B06208, doi:10.1029/2011JB008351, 2011
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49. **Gelman, S.E.**, L.T. Elkins-Tanton, and S. Seager, Mantle evolution in tidally locked terrestrial planets: Degree-1 convection and implications for habitability, *The Astrophysical Journal* 735, 1–8, DOI: 10.1088/0004-637X/735/2/72, 2011.
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45. Elkins-Tanton, How much water does it take to be wet? Water on the Moon, invited Quick Study in Physics Today, March 2011.
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38. Smrekar, Suzanne E., E.R. Stofan, N. Mueller, A. Treiman, L. Elkins-Tanton, J. Helbert, Recent hotspot volcanism on Venus from VIRTIS emissivity data, *Science* 328, 605-608, 2010.

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37. Miller-Ricci, E., M. Meyer, S. Seager, L. Elkins-Tanton, On the emergent spectra of hot protoplanet collision afterglows, *Astrophysical Journal* 704, 770-780, 2009.
36. **Brown, S.** and L. T. Elkins-Tanton, Composition of Mercury's oldest crust from magma ocean models, *Earth and Planetary Science Letters* 286, 446-455, 2009.
35. West, John D., Matthew J. Fouch, Jeffrey B. Roth, Linda T. Elkins-Tanton, Vertical mantle flow associated with a lithospheric drip beneath the Great Basin, *Nature Geoscience* 2, 438-443, 10.1038/NGEO526, 2009.
34. McCanta, M., L. Elkins-Tanton, M.J. Rutherford, Expanding the application of the Eu-oxybarometer to the Iherzolitic shergottites and nakhlites: implications for the oxidation state heterogeneity of the Martian interior, *Meteoritics and Planetary Science* 44(5), 725-745, 2009.

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32. Elkins-Tanton L.T. and S. Seager, Coreless terrestrial exoplanets, *Astrophysical Journal* 688, 628-635, 2008.
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29. Elkins-Tanton L.T., Linked magma ocean solidification and atmospheric growth for Earth and Mars, *Earth and Planetary Science Letters* 271, 181-191, 2008.
28. Adams E.R., S. Seager, L. Elkins-Tanton, Ocean planet or thick atmosphere: On the mass-radius relation for solid exoplanets with massive atmospheres, *Astrophysical Journal* 673, 1160-1164, 2008.
27. Farmer, G.L., T. Gailley, L.T. Elkins-Tanton, Mantle "source volumes" and the origin of the mid-Tertiary ignimbrite flare-up in the southern Rocky Mountains, Western U.S., *Lithos* 102, 279-294, 2008.

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21. Barr, J., T.L. Grove, L. Elkins-Tanton, High-magnesian andesite from Mount Shasta: A product of magma mixing and contamination, not a primitive melt: Comment and reply. *Geology* 35, p 147, doi: 10.1130/G24058C.1, 2007.
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- 2005
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18. Elkins-Tanton L.T. and B. H. Hager, Giant meteoroid impacts can cause volcanism, *Earth and Planetary Science Letters*, 239, 219-232, doi: 10.1016/j.epsl.2005.07.029, 2005.
17. Elkins-Tanton L.T., S. Zaranek, and E.M. Parmentier, Early magnetic field and magmatic activity on Mars from magma ocean overturn, *Earth and Planetary Science Letters* 236, 1-12, 2005.
16. Elkins-Tanton L.T., Continental magmatism caused by lithospheric delamination, in *Plates, Plumes, and Paradigms*, eds. G.R. Foulger, J.H. Natland, D.C. Presnall, D.L. Anderson, Geological Society of America, 449-461, 2005.
15. Grove T.L., M.B. Baker, R.C. Price, S.W. Parman, L.T. Elkins-Tanton, N. Chatterjee, and O. Müntener, Magnesian andesite and dacite lavas from Mt. Shasta, northern California: products of fractional crystallization of H<sub>2</sub>O-rich mantle melts. *Contributions to Mineralogy and Petrology*: DOI: 10.1007/s00410-004-0619-6, 2005.
- 2004
14. Elkins-Tanton L.T., B. H. Hager, and T.L. Grove, Magmatic effects of the Lunar Late Heavy Bombardment. *Earth and Planetary Science Letters*: 222, 17-27, 2004.
13. Kelly, D.C. and L.T. Elkins-Tanton, Bottle-green microtektites from the South Tasman Rise: Deep-sea evidence for an impact event near the Miocene/Pliocene boundary, *Meteoritics and Planetary Science* 39, 1921-1929, 2004.
- 2003
12. Elkins-Tanton L.T. and T.L. Grove, Evidence for deep melting of hydrous, metasomatized mantle: Pliocene high potassium magmas from the Sierra Nevadas, *Journal of Geophysical Research*: 108, 2350, DOI 10.1029/2002JB002168, 29 July 2003.
11. Elkins-Tanton L.T., P. Aussillous, J. Bico, D. Quéré, J.W.M. Bush, A laboratory model of splash-form tektites, *Meteoritics and Planetary Science*: 38, 1331-1340, 2003.
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9. Elkins-Tanton L.T., N. Chatterjee, and T.L. Grove, Magmatic processes that produced lunar fire fountains, *Geophysical Research Letters*: 30(10), p. 1513, DOI 10.1029/2003GL017082, 2003.

8. Grove T.L., L.T. Elkins-Tanton, S.W. Parman, N. Chatterjee, O. Müntener, G.A. Gaetani, Fractional crystallization and mantle-melting controls on calc-alkaline differentiation trends, Contributions to Mineralogy and Petrology: 145, p 515-533, DOI 10.1007/s00410-003-0448-z, 2003.
  7. Elkins-Tanton L.T., N. Chatterjee, and T.L. Grove, Experimental and petrological constraints on lunar differentiation from the Apollo 15 green picritic glasses, Meteoritics and Planetary Science: 38, 515-527, 2003.
- 2002 and previous
6. Elkins-Tanton L.T., J. A. Van Orman, B. H. Hager, and T. L. Grove, Reexamination of the lunar magma ocean cumulate overturn hypothesis: Melting or mixing is required, Earth and Planetary Science Letters: 196, 249-259, 2002.
  5. Elkins Tanton L.T., T.L. Grove, and J. Donnelly-Nolan, Hot shallow melting under the Cascades volcanic arc, Geology: 29, 631-634, 2001.
  4. Elkins Tanton L.T. and Bradford H. Hager, Melt intrusion as a trigger for lithospheric foundering and the eruption of the Siberian flood basalt, Geophysical Research Letters: 27, 3937-3940, 2000.
  3. Elkins L.T., T.L. Grove, J. Delano, V. Fernandez, Origin of lunar ultramafic green glasses: Constraints from phase equilibrium studies, Geochimica et Cosmochimica Acta: 64, 2339-2350, 2000.
  2. Elkins, Linda T. and Timothy L. Grove, Ternary feldspar experiments and thermodynamic models, American Mineralogist: 75, 544-559, 1990.
  1. Karig, D.E. and L.T. Elkins, Geology of the Cayuga Lake region, NYSGA Annual Meeting Guidebook, 1986.

## BOOKS

*A Portrait of the Scientist as a Young Woman*, 2022, William Morrow, Lindy Elkins-Tanton

*Earth*, Bloomsbury Academic, 2017, Jeffrey Jerome Cohen and L.T. Elkins-Tanton.

*Planeteimals: Early Differentiation and Consequences for Planets*, (edited volume) Cambridge University Press, 2017, editors L.T. Elkins-Tanton and B. Weiss.

*Volcanism and Global Environmental Change*, (edited volume) Cambridge University Press, 2015, editors A. Schmidt, K. Fristad, L.T. Elkins-Tanton.

*The Solar System*, a six-book reference series, published by Chelsea House, an imprint of Facts on File, Inc, 1<sup>st</sup> edition 2006; 2<sup>nd</sup> edition 2010, L.T. Elkins-Tanton.

*The Sun, Mercury, and Venus, The Earth and the Moon, Mars, Asteroids, Meteorites, and Comets, Jupiter and Saturn, Uranus, Neptune, Pluto, and the Outer Solar System*

## SPACECRAFT PROPOSAL, REVIEW, AND MISSION INVOLVEMENT

Psyche Discovery mission, Principal Investigator, 2011 – present. Selected for flight as Discovery 14 Jan. 2017.

Mars Sample Caching Strategy Steering Committee member 2020 – 2021.

Standing Review Board for the NASA Europa Clipper flagship mission, 2016 – present.

Europa Lander Tiger Team, 2017.

Europa Clipper Instrument Risk Assessment Team, 2020.

VERITAS Venus orbiter Discovery mission proposal, Co-I, 2010 - 2015. PI: S. Smrekar.

Mars 2020 Rover, Science Definition Team member, 2013.

Athena, SIMPLEX proposal, Co-I 2018, 2020. PI: J. O'Rourke.

SAGE Venus lander, New Frontiers proposal, Co-I, 2010 - 2012. PI: Larry Esposito. Reached Phase A in 2011.

International Lunar Network, Science Definition Team member, 2008.

## HONORS AND AWARDS

Member of the National Academy of Sciences, 2021

NASA Group Achievement Award for outstanding execution and successful completion of the formulation phase of Psyche mission, 2020  
Arthur L. Day Prize and Lectureship, National Academy of Sciences, 2020  
Fellow of the Meteoritical Society, 2020  
Speaker at Chile's Congreso Futuro, 2020  
The Flatté Lecture in Science at UC Santa Cruz, 2019  
Member of the American Academy of Arts and Sciences, 2018  
Fellow of the American Mineralogical Society, 2017  
Fellow of the American Geophysical Union, 2016  
Thomas A. Mutch Lecture at Brown University, 2016  
Mineralogical Society of America Distinguished Lecturer, 2013-2014  
The Goldsmith Lecture, University of Chicago, 2014  
The Wilson Lecture, University of Oslo, Norway, 2014  
Astor Fellow, Oxford University, 2013, including the first Lobanov Planetary Science Lectureship  
Masursky Lecture, Lunar and Planetary Science Conference, 2013  
Asteroid (8252) Elkins-Tanton  
Lowell Thomas Award from The Explorers Club, 2010  
Outstanding MIT Faculty Undergrad Research Mentor Award, 2008-2009  
MIT Mitsui Career Development Chair, 2008-2011  
NAS Kavli Fellow, Frontiers of Science, U.S. (participant), 2008  
NAS Kavli Fellow, Frontier of Science France-US, France (speaker), 2008  
National Science Foundation CAREER award, June, 2008  
National Defense Science and Engineering Graduate fellowship, 1997-2000  
Amelia Earhart graduate fellowships from Xonta International, 1999 and 2000

## SERVICE

Congreso Futuro, Chile, Advisory Board, 2021 – present  
Our Future Life Advisory Board, 2022 - present  
Intelligence Science and Technology Experts Group, National Academy of Sciences, 2015 – present  
New Space Editorial Board founding member, 2012 – present  
Open Lunar board member, 2018 – present  
MILO Institute board member, 2018 – present  
The Hague Space Resources Technical Panel, 2018  
The Explorers Club Space Advisory Committee member, 2013 – 2016  
Centre for Earth Evolution and Dynamics, Oslo, Int'l Advisory Board Member, 2012 – 2017  
NAS Committee on Astrobiology and Planetary Science (CAPS), 2012 – 2015  
Planetary Division of the American Geophysical Union Secretary, 2010 – 2012, President-Elect, 2012 – 2014, President, 2015 – 2016  
Flag and Honors Committee, The Explorers Club, 2011 – 2013  
Journal of Geophysical Research: Planets Associate Editor, 2010 – 2012  
NAS Decadal Survey for Planetary Science, 2009-2010, Mars Panel Member  
Proposal reviewer for NASA, NSF, NOW (Netherlands), NERC (United Kingdom), ETH (Eidgenössische Technische Hochschule), DFG (Germany); service on numerous panels.

## POSTDOCTORAL, GRADUATE, AND UNDERGRADUATE RESEARCHERS SUPERVISED

Carver Bierson, ASU postdoctoral fellow, 2020 – present.  
Kevin Hubbard, ASU Ph.D. student, 2017 – present.  
John Morgan Christoph, ASU Ph.D. student 2017 – present.

Hannah Bercovici, ASU Master's student, 2017 – 2020.

Joe O'Rourke, ASU Exploration Fellow, 2017 – 2019; now tenure-track faculty at ASU.

Laura Schaefer, ASU postdoctoral fellow 2016-2018; now tenure-track faculty at Stanford University.

Kaveh Palevan, ASU postdoctoral fellow 2016 – 2018.

Terrence Blackburn, Carnegie postdoctoral fellow 2012-2014, now tenure-track faculty at UC Santa Cruz.

Aaron Scheinberg, MIT Ph.D. 2015, Mantle dynamics and geodynamo in the early solar system, now private sector in Boston.

Benjamin Black, MIT Ph.D., 2013, Links between the volcanism and atmospheric chemistry, subsequently postdoc at Berkeley, now faculty at Rutgers.

Jenny Suckale, MIT Ph.D. 2011, Numerical models of bubbles and crystals in magmatic systems, subsequently fellow at Harvard University, now tenure-track faculty at Stanford University.

Stephanie Brown, MIT S.B. Thesis 2010, S.M. 2011.

Alessondra Springmann, MIT S.M. 2011

Sean Wahl, MIT S.B. Thesis 2011, now postdoc at Berkeley.

Danielle Piskorz, MIT S.B. 2011, subsequently Ph.D. at CalTech, now Aerospace Corporation.

Romain Meyer, MIT Postdoctoral scholar 2008-2010, now researcher at U. Bergen.

Sarah Gelman, MIT S.B. Thesis, 2009, Goetze award for best thesis, now senior geologist at ExxonMobil.

Andrew Thorpe, B.S. Honors Thesis 2004 at Brown University.

Jessica Jewell, B.S. Honors Thesis 2004 at Brown University. Now Research Scholar at the International Institute for Applied Systems Analysis.

Secondary Advisor for:

Sam Courville, ASU Ph.D. student, 2020 – present.

Lena Heffern, ASU Ph.D. student, graduated 2022

Steven Dibb, ASU Ph.D. student, graduated 2021

Christy Till, MIT Ph.D. student

Seth Burgess, MIT Ph.D. student

Roger Fu, MIT Ph.D. student

Ben Mandler, MIT Ph.D. student

Sonia Tikoo, MIT Ph.D. student

#### TEACHING EXPERIENCE (NOT INCLUDING TEACHING OF PROFESSIONAL DEVELOPMENT CLASSES)

The following ASU courses all used the Beagle question cycle to train students in conducting a literature review, assessing the quality of their sources, asking their own questions, and progressing toward a goal. The courses are driven by the students' questions.

ASU IPI296/496, Online Open Inquiry: Space, Fall 2020, Spring 2021, Fall 2021

ASU IPI296-SES598, What is life and can we detect it on icy moons, Spring 2021

ASU IPI296-SES598, Sustainable Space Exploration, Spring 2020

ASU SES494-591, Human Biosystem in Space, Fall 2019

ASU SES494-591, Planetary Life Detection, Spring 2019

ASU SES494-591, Introduction to Interplanetary Initiative Research, Fall 2018

ASU SES494-591, The Moon After Settlement, Fall 2018

ASU SES494-591, Earth Without Life, Fall 2017

ASU SES494-591, Life on Small Worlds, Fall 2016

ASU SES395, Exploration: The Human Imperative, Spring 2016. Spring 2017.

ASU SES494-591, Detecting Habitable Planets, Fall 2015

MIT 12.001, Introduction to Geology, Spring 2007, Spring 2008. This course is MIT's introduction to geology for undergraduate majors and included a strong lab component. The subject was rated 6.1/7 and I was rated 6.6/7.

MIT 12.472, Building Earth-like planets: From nebular gas to ocean worlds, Fall 2008, Fall 2009, Spring 2011. A graduate investigation in the current understanding of how planets form and what makes them habitable. The subject was rated 6.7/7 and I was rated 6.5/7.

MIT 12.470, Essentials of Geology, Spring 2009, Spring 2010 This course was an intense, one-semester introduction for physics, math, and engineering students entering Ph.D. programs in Earth and planetary science. The subject was rated 6.3/7 and I was rated 6.7/7.

MIT 21L.A23/12.A41, Catastrophes, tedium, discoveries: When expeditions do science, Fall 2009. This freshman seminar on the historic place of science in exploration covered the *Beagle* and the American Exploration Expedition, as well as space flight and searches for the northwest passage.

Earth and Space Science, a summer course for middle- and high-school science teachers, Summer 2010, 2011, 2012, 2013. Originally funded through my CAREER grant, this course brought secondary-school teachers up to date on the science and integrated the needed math at each step. Assessments were very high, and we attracted teachers from five states.

For two years before beginning my Ph.D. I taught full-time as a lecturer in mathematics at St. Mary's College of Maryland, the University of Maryland's honors college. At St. Mary's I taught ten courses, including general geology, calculus, precalculus, statistics, number theory, and mathematical modeling, and received consistently high teaching assessments even in general service mathematics classes.

## RESEARCH CONTRACTS AND GRANTS

Title	Agency	Total Funds	Duration	E-T %	Role
Psyche: Journey to a Metal World	NASA Discovery Program	\$783M	2017-2028	9%	PI
Variability and Abundance of Hydration on M-Type Asteroid (16) Psyche: The search for water on the largest metallic asteroid	Space Telescope Foundation	James Webb Space Telescope time in Cycle 1	2022	0%	Co-I with PI S. Jarmak, SwRI
SBIR Phase I: Training Platform and Machine Learning for Faster Team Problem Solving	AFWERX	\$49,998	2020 3 mths	0%	Co-I with PI T. Bohlen, Beagle Learning
SBIR Phase I: Creating the Critical University-to-Workforce Connection: Providing Quantitative Evidence of Collaboration Skills	NSF Education	\$185,500	2019 - 2020	0%	Co-I with PI T. Bohlen, Beagle Learning
Psyche's UV Reflectance Spectra: Exploring the origins of the largest exposed-core metallic asteroid	Space Telescope Foundation	Hubble time allocation	2017	0%	Co-I with PI T. Becker, SwRI
Water from the Heavens: The Origins of Earth's Hydrogen	Keck Foundation	\$1,500,000	1/1/2016 - 12/31/2018	3%	Co-I with PI P. Buseck, ASU
Psyche: Mission to a metal world (NNM16AA09C, NNN12AA01C)	NASA	\$3,000,000	11/13/15 – 11/12/16	12%	PI
STEM Education Exploration Connection (NNX16AD79A)	NASA	\$10,183,000	1/1/16 – 1/1/21	50%	PI (later passed to Ariel Anbar)
How strong is the Venusian crust? The roles of trace amounts of water and ductile shear zones	NASA Solar System Workings	\$357,053	7/1/15- 6/30/18	0%	Collaborator with PI D. Kohlstedt, U Minn.
Infrastructure for Interdisciplinary Research in Earth and Space Science at the Carnegie Institution (0963396)	NSF ARI	\$1,093,000	9/1/2010 – 9/1/2014	100% for infrastructure	PI from 2011-2014

Collaborative Research: Application of siderophile elements to mantle geodynamics (1160656, 1160728)	NSF CSEDI	\$545,965	5/1/2012 – 4/30/2016	31%	Co-I with PI R. Walker, U MD
ASGARD: Development of a seismometer for planetary applications (NNX10AJ84G)	NASA Planetary Instrumentation Dev.	\$899,919	6/1/10 – 5/30/13	16%	Co-I with PI Draper Labs
Upgrade of the Alliance for Computational Earth Science (ACES) High Performance Computing Facility	NSF EAR Instrumentation and Facilities	\$75,000	5/1/10 – 4/30/11	100% for infrastructure	Co-I with PI B. Hager, MIT
Catastrophes, tedium, discoveries: When expeditions do science	MIT Research Funds	\$16,388	6/1/09 – 6/1/10	50%	Co-I with PI M. Fuller, MIT
Lunar volatiles and magma ocean differentiation: Reconciling new results with old ideas (NNX09AM63G)	NASA LASER	\$173,481	7/1/09 – 6/30/12	20%	Co-I with PI M. McCanta, Tufts
Moon as cornerstone to the terrestrial planets: The formative years (NNA09DB34A)	NASA Lunar Institute	\$2,790,282	8/1/2011 – 7/31/2014	100% for shared students	Team member with PI C. Pieters, Brown U., & Institutional PI M. Zuber, MIT
Unusual lavas in Arctic Siberia: Connections to the world's largest volcanic event, the world's largest extinction, and river channels on Venus	MIT Research grant from the Wade fund	\$50,000	7/1/08 – 6/30/09	100%	PI
Collaborative research: The Siberian Traps and the end-Permian extinction: Coincidence and causality (0807585 etc)	NSF Continental Dynamics	\$3,000,000	8/1/08 – 7/31/13	44%	Lead PI
CAREER: Building rocky planets: From Mercury and Vesta to GL 581c	NSF Astronomy	\$724,320	3/7/08 – 5/31/13	100%	PI
The role of water in the early formation of Mars: Wet magma ocean crystallization, the growth of a water atmosphere, and retention of water in the mantle (NNX06AB18G)	NASA Mars Fundamental Research	\$258,025	6/1/06 – 1/31/11	100%	PI
Collaborative research: Lithospheric removal: The Sierra Nevada as the prototype of a fundamental process in mountain building	NSF Continental Dynamics	\$102,297	9/1/06 – 8/31/10	100%	PI
Consequences of tidal heating on the internal evolution of the early Earth, with comparison to Venus, Mars, and Mercury	Strategic University Research Partnership MIT-JPL	\$19,320	7/1/08- 6/30/09	100%	PI
The lithosphere-asthenosphere boundary: Integrated modeling of scattered wave observations and mantle dynamics	NSF Geophysics	\$380,000	4/1/06 – 3/31/09	50%	Co-I with PI K. Fischer, Brown U.
Workshop on the Siberian traps and the end-Permian extinction	NSF Continental Dynamics	\$20,075	9/1/05 – 12/31/06	100%	PI
Early crustal formation on Mars	NASA Mars Fundamental Research	\$54,361	7/1/05 – 12/31/06	100%	PI
Petrology and physics of magma ocean crystallization (NNG04GB30G)	NASA Mars Fundamental Research	\$48,700	4/1/04 – 3/31/05	100%	PI
Lithospheric controls on flood basalt volcanism (EAR-0309057)	NSF Petrology & Geochem.	\$113,912	7/1/03 – 12/1/05	100%	PI

#### SELECTED ESSAYS, ARTICLES, TALKS, INTERVIEWS

- NBC *Today Show* profile July 11 2022 <https://www.today.com/video/how-one-mom-started-her-phd-at-31-and-made-nasa-history-143801413612>

- Elkins-Tanton, [Time to Say Goodbye to Our Heroes?](#) *Issues in Science and Technology*, 2021.
- Learning Futures Podcast [Collaborative Problem-Solving with Meaningful Action](#) released Sept 21st 2021
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- Utah Public Radio interview [Undisciplined: Prehistory Repeats Itself](#), 2020
- Storycorps [interview](#), 2019
- [Testimony \(video\)](#) to the Senate Commerce, Science, and Transportation subcommittee on the NASA workforce and STEM education, 2019
- American Academy of Arts and Sciences [Class 1 Speaker](#), 2018 Induction Ceremony
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- Elkins-Tanton, [Our Solar System was born Through High-Energy Crashes, Not Stately Growth](#), *Scientific American*, 2016.
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