

## Linda Tarbox Elkins–Tanton

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### Education

Ph.D., Geology and Geophysics, T.L. Grove and B. H. Hager

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|--------------------------------|---------------------------------------|------|
|                                | Massachusetts Institute of Technology | 2002 |
| M.S., Geochemistry, T.L. Grove | Massachusetts Institute of Technology | 1987 |
| B.S., Geology                  | Massachusetts Institute of Technology | 1987 |

### Appointments and employment

|  |                                       |              |
|--|---------------------------------------|--------------|
| Post-Doctoral Research Associate   | Brown University                      | 2002-present |
| Post-Doctoral Research Associate   | Massachusetts Institute of Technology | Summer 2002  |
| Graduate student   | Massachusetts Institute of Technology | 1997-2002    |
| Instructor in Mathematics  | St. Mary's College of Maryland        | 1995-1997    |
| Principal, Business Plan Writing, Annapolis, MD. Consulted to technology companies |                                       | 1990-1995    |
| Circulation Analyst, US News & World Report, Washington DC. Forecast income        |                                       | 1989-1990    |
| Interim Publisher, International Wine Review Magazine, Ithaca, NY                  |                                       | 1988-1989    |
| Research Associate, Touche Ross & Co. Management Consulting, Philadelphia, PA      |                                       | 1987-1988    |

### Research interests

Mantle differentiation and the dynamic processes that lead to mantle melting.

Long-term goal: to better understand the convective and volcanic processes that lead to lateral and radial heterogeneities on a range of scales in the mantles of terrestrial planets, with focuses on early planetary evolution as well as large igneous provinces and continental magmatism.

Approaches: experimental petrology, experimental fluid dynamics, numerical modeling, field work.

### Papers published or submitted

- Elkins-Tanton L.T., E.M. Parmentier, P.C. Hess, The formation of ancient crust on Mars through magma ocean processes, submitted to *Journal of Geophysical Research*, 2005.
- Elkins-Tanton L.T. and B. H. Hager, Giant impact craters lead to flood basalts: A viable model, in revision for *Earth and Planetary Science Letters*.
- Elkins-Tanton L.T., S. Zaranek, and E.M. Parmentier, Early magnetic field and magmatic activity on Mars from magma ocean overturn, accepted by *Earth and Planetary Science Letters*, 2005.

- Elkins-Tanton L.T., Continental magmatism caused by lithospheric delamination, accepted for upcoming book *Melting anomalies: Their Nature and Origin*, eds. G.R. Foulger, J.H. Natland, D.C. Presnall, D.L. Anderson, Geological Society of America, 2005.
- Kelly, D.C. and L.T. Elkins-Tanton, A possible new tektite strewn field at 5 Ma, *Meteoritics and Planetary Science* 39, 1921-1929, 2004.
- 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, 2004.
- 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.
- Elkins-Tanton L.T., B.H. Hager, and T.L. Grove, Lunar impact processes. Contribution to the upcoming book *New Views of the Moon*, Lunar and Planetary Science Institute, Houston.
- Parmentier E.M. and L.T. Elkins-Tanton, Physics of magma ocean crystallization. Contribution to the upcoming book *New Views of the Moon*, Lunar and Planetary Science Institute, Houston.
- 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.
- Elkins-Tanton L.T., P. Aussillous, J. Bico, D. Quéré, J.W.M. Bush, A laboratory investigation of tektites, *Meteoritics and Planetary Science*: 38, 1331-1340, 2003.
- Elkins-Tanton L.T., E.M. Parmentier, and P.C. Hess, Magma ocean fractional crystallization and cumulate overturn in terrestrial planets: Implications for Mars, *Meteoritics and Planetary Science*: 38, 1753-1771, 2003.
- 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.
- 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.
- 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.
- 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.
- Elkins-Tanton L.T., T.L. Grove, and J. Donnelly-Nolan, Hot shallow melting under the Cascades volcanic arc, *Geology*: 29, 631-634, 2001.
- 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.

## **Linda T. Elkins-Tanton**

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- 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.
- Elkins, Linda T. and Timothy L. Grove, Ternary feldspar experiments and thermodynamic models, *American Mineralogist*: 75, 544-559, 1990.
- Karig, D.E. and L.T. Elkins, Geology of the Cayuga Lake region, *NYSGA Annual Meeting Guidebook*, 1986.

### **Papers in preparation**

- Elkins-Tanton L.T., Topography, magmatism, and a heterogeneous mantle from lithospheric delamination: results from numerical modeling, in preparation.
- Elkins-Tanton L.T., P.C. Hess, S. Smrekar, T. Hoogenboom, E.M. Parmentier, A heterogeneous mantle and magmatism with two viscosities on Venus: results from numerical and petrologic modeling, in preparation.
- Elkins-Tanton L.T., D. Draper, J. Jewell, A. Thorpe, C. Agee, Lithosphere-derived volatiles in the mantle produced the last magmas in the Siberian flood basalts: Experimental results, in preparation for submission to *Contributions to Mineralogy and Petrology*.
- Cagnioncle A.M., Rilling J.L., L.T. Elkins-Tanton, and E.M. Parmentier, Melting due to buoyant migration of water in the hot mantle wedge above a subducting plate, in preparation.

### **Grants and fellowships**

- Early crustal formation on Mars  
P.I., NASA Mars Fundamental Research                      5/1/05 – 6/1/06                      \$54,361
- Lithospheric controls on flood basalt volcanism  
P.I., NSF EAR Petrology and Geochemistry grant    7/1/03 – 7/1/05                      \$113,912
- Petrology and physics of magma ocean crystallization  
P.I., NASA Mars Fundamental Research grant        4/1/04 – 4/1/05                      \$48,713
- National Defense Science and Engineering Graduate fellowship, 1997-2000, full tuition plus stipend.
- Amelia Earhart graduate fellowships, 1999 and 2000, from the Xonta International Foundation (two year limit).

### **Current collaborations**

- Marc Parmentier and Paul Hess at Brown Univ.    Magma ocean processes and lunar and Martian evolution
- Karen Fischer at Brown Univ.                      Mantle flow under continents
- Sam Bowring at MIT                                    Integrated field studies of the Siberian flood basalts and their possible links to the end-Permian extinction
- Maria Zuber and Sabine Stanley at MIT            Production of the Martian magnetic field
- Sue Smrekar and Trudi Hoogenboom at JPL        Lithospheric evolution of Venus
- Dave Draper and Carl Agee at the UNM            High-pressure experiments on a primitive Siberian flood basalt composition

**Academic service etc.**

Memberships: Sigma Xi, AGU, GSA, Meteoritical Society.

Wrote *The Solar System*, a six-book reference series for colleges and high schools, for publisher Facts on File. In production, publication date Dec. 2005.

Proposal reviewer for: NASA  
The National Science Foundation

Paper reviewer for: *Contributions to Mineralogy and Petrology*  
*Earth and Planetary Science Letters*  
*Geochimica et Cosmochimica Acta*  
*Geological Society of America Bulletin*  
*Journal of Geophysical Research*  
*Journal of Metamorphic Geology*  
*Journal of Petrology*  
*Nature*  
*Tectonophysics.*

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| Invited talks: | California Institute of Technology     | February 2005  |
|                | Massachusetts Institute of Technology  | February 2005  |
|                | Brown University                       | February 2005  |
|                | University of Massachusetts at Amherst | November 2004  |
|                | Harvard University                     | September 2004 |
|                | Carnegie Institute of Washington, DTM  | March 2004     |
|                | Rice University                        | March 2004     |
|                | Wood's Hole Oceanographic Institute    | February 2004  |
|                | Princeton University                   | November 2003  |
|                | University of Wisconsin at Madison     | October 2003   |
|                | University of Chicago                  | October 2003   |
|                | EGS/AGU/EUG joint meeting (two talks)  | April 2003     |
|                | Wood's Hole Oceanographic Institute    | January 2003   |
|                | Brown University                       | November 2001  |
|                | Brown University                       | October 2000   |

**Students advised**

Andrew Thorpe, "Evidence from experimental petrology for olivine addition in meimechite magma generation"  
Senior honors thesis, Brown University, 2004 (Bachelor's degree)

Jessica Jewell, "An experimental study of meimechites: Evidence for shallow melting and subsequent fractionation in the Siberian flood basalts" Senior honors thesis, Brown University, 2004 (Bachelor's degree)

**Papers presented at conferences**

1. Elkins, Linda T. and Timothy L. Grove, Phase equilibrium investigations of ternary feldspars, Geological Society of America Abstracts, 1987.
2. Stark, R, L.T. Elkins, S. Strickland, Conveying the beauty of mathematics in a liberal arts course, Mathematical Association of America mid–Atlantic Spring conference, 1996.
3. Grove T.L., G.A. Gaetani, S.W. Parman, and L.T. Elkins, Mass transfer processes in the southern Cascade subduction zone: The influence of variable water content on mantle melting, Materials Recycling near Convergent Plate Boundaries, Carnegie Institute of Washington, Puerto Azul, Philippines, p.24, 1997.
4. Van Orman J., L.T. Elkins, T. L. Grove, Origin of high-Ti lunar ultramafic glasses: Experimental evidence from melting of magma ocean cumulates and depths of positive buoyancy for melts of varying Ti-content, Lunar and Planetary Science Conference XXX Abstracts, 1999.
5. Elkins, L.T. and T.L. Grove, Origin of lunar ultramafic green glasses: Constraints from phase equilibrium studies, Lunar and Planetary Science Conference XXX Abstracts, 1999.
6. Donnelly-Nolan J., L.T. Elkins, T.L. Grove, Primitive high-alumina olivine tholeiites from Medicine Lake Volcano — Mt. Shasta region, N. California: Depths and extents of mantle melting, American Geophysical Union Abstracts, Fall Meeting, 1999.
7. Elkins, L.T. and B. Hager, An emplacement model for the Siberian flood basalts to fit geologic, tectonic, and paleoclimatic constraints, American Geophysical Union Abstracts, Fall Meeting, 1999.
8. Elkins Tanton, L.T., J.A. Van Orman, B.H. Hager, and T.L. Grove, Constraints on early lunar high titanium cumulate overturn, Workshop on New Views of the Moon III Abstracts, Lunar and Planetary Institute, Houston TX, 2000.
9. Elkins Tanton, L.T. and T.L. Grove, Lunar mantle composition and thermal history: Constraints from phase equilibrium studies, Workshop on New Views of the Moon III Abstracts, Lunar and Planetary Institute, Houston TX, 2000.
10. Elkins Tanton, L.T. and B.H. Hager, Giant impact craters lead to flood basalts: A viable model, GSA Annual Meeting Abstracts, 2000.
11. Elkins Tanton, L.T. and T.L. Grove, Lunar mantle compositions and thermal history: Constraints from phase equilibrium studies, Lunar and Planetary Science Conference XXXII Abstracts, 2001.
12. Elkins Tanton, L.T., J.A. Van Orman, and T.L. Grove, Is the sinking high-Ti cumulate hypothesis sunk? Lunar and Planetary Science Conference XXXII Abstracts, 2001.
13. Elkins Tanton, L.T., B.H. Hager, and T.L. Grove, Magmatic effects of the lunar late heavy bombardment, American Geophysical Union Abstracts, Spring Meeting, 2001.
14. Elkins Tanton, L.T. and T.L. Grove, Evidence of a Deep Origin for Primitive Pliocene Absarokites From the Sierra Nevada, California, American Geophysical Union Abstracts, Fall Meeting, 2001.
15. Elkins Tanton, L.T., B.H. Hager, and T.L. Grove, Magmatic effects of the lunar late heavy bombardment, Lunar and Planetary Science Conference XXXIII Abstracts, 2002.
16. Elkins-Tanton, L.T., D.C. Kelly, J. Bico, J.W.M. Bush, Microtektites as vapor condensates, and a possible new strewn field at 5 Ma, Lunar and Planetary Science Conference XXXIII Abstracts, 2002.

17. Kelly, C.K., L.T. Elkins-Tanton, Bottle-green microtektites from the South Tasman Rise (ODP Site 1169): Evidence for an impact near the Miocene/Pliocene boundary, GSA Annual Meeting Abstracts, 2002.
18. Parmentier, E.M. and L.T. Elkins-Tanton, Convection and layering in the Martian mantle, Unmixing the SNCs: Chemical, Isotopic, and Petrologic Components of the Martian Meteorites, workshop at the Lunar and Planetary Science Institute, Houston TX, October 2002.
19. Elkins-Tanton L.T. and T.L. Grove, Evidence for the formation of Pliocene Sierran high potassium magmas from deep melting of a phlogopite-clinopyroxene metasomatized peridotite, American Geophysical Union Abstracts, Fall Meeting, 2002.
20. Grove T.L., L.T. Elkins-Tanton S.W. Parman, N. Chatterjee, G.A. Gaetani, O. Müntener, Mantle melting controls on liquid lines of descent in magmatic systems, American Geophysical Union Abstracts, Fall Meeting, 2002.
21. Elkins-Tanton L.T., E.M. Parmentier, P.C. Hess, A model for Martian magma ocean crystallization and overturn, Lunar and Planetary Science Conference XXXVIII Abstracts, 2003.
22. Elkins-Tanton L.T., N. Chatterjee, T.L. Grove, Magmatic processes that produced lunar fire fountains: Evidence from vesicular rims on picritic glass beads, Lunar and Planetary Science Conference XXXVIII Abstracts, 2003.
23. Elkins-Tanton L.T., E.M. Parmentier, P.C. Hess, A model for Martian magma ocean crystallization and overturn, EGS/AGU/EUG combined meeting abstracts, Spring 2003. INVITED.
24. Elkins-Tanton L.T., P. Aussillous, J. Bico, D. Quéré, J.W.M. Bush, A laboratory model for splash-form tektites, EGS/AGU/EUG combined meeting abstracts, Spring 2003. INVITED.
25. Grove, T.L., Parman, S.W., Elkins-Tanton, L.T., and Müntener, O., Mantle melting and plate tectonic controls on magmatism in the cascade arc: a petrologic perspective, GSA Annual Meeting Abstracts, 2003.
26. Grove, T.L., Elkins-Tanton, L.T., and Hesse, M., Melting processes in continental lithosphere: effects of mantle metasomatism on melt composition, GSA Annual Meeting Abstracts, 2003.
27. Rilling J.L., A.M. Cagnioncle, L.T. Elkins-Tanton, and E.M. Parmentier, Melting due to Buoyant Migration of Water in the Hot Mantle Wedge Above a Subducting Plate, American Geophysical Union Abstracts, Fall Meeting, 2003.
28. Elkins-Tanton L.T., Jessica Jewell, and Paul C. Hess, Preliminary experimental results on a meimechite composition from Meymecha, Siberia, American Geophysical Union Abstracts, Fall Meeting, 2003.
29. Elkins-Tanton L.T. and E.M. Parmentier, Consequences of high crystallinity for the evolution of the lunar magma ocean: trapped plagioclase, Lunar and Planetary Science Conference XXXV Abstracts, March 2004.
30. Zaraneck S.E., E.M. Parmentier, and L.T. Elkins-Tanton, Overturn of unstably stratified, inhomogeneous fluids: Implications for the early evolution of planetary mantles, Lunar and Planetary Science Conference XXXV Abstracts, March 2004.
31. Cagnioncle A.M., L.T. Elkins-Tanton, and E.M. Parmentier, Melting and Fluid Migration in the Hot Mantle Wedge Above a Subducting Plate, American Geophysical Union Abstracts, Spring Meeting, 2003.

32. Zaranek S.E., Elkins-Tanton L.T, Parmentier E.M., Role of Compositional Stratification on the Evolution of Planets, Computer Measurement Group Conference 2004, Courant Institute of Mathematical Sciences, New York, June 2004.
33. Elkins-Tanton L.T., S.E. Zaranek, and E.M. Parmentier, Martian early magnetic field as a result of magma ocean cumulate overturn, Workshop on Hemispheres apart: the origin and modification of the Martian crustal dichotomy, Houston TX, October 2004.
34. Elkins-Tanton L.T., S.E. Zaranek, and E.M. Parmentier, Martian early crust as a result of magma ocean cumulate overturn, Workshop on Hemispheres apart: the origin and modification of the Martian crustal dichotomy, Houston TX, October 2004.
35. Elkins-Tanton L.T., S.E. Zaranek, and E.M. Parmentier, Magma ocean cumulate overturn: Generation of an early magnetic field, Second Conference on Early Mars: Geologic, hydrologic, and climatic evolution and implications for life, Jackson Hole WY, October 2004.
36. Elkins-Tanton L.T., S.E. Zaranek, and E.M. Parmentier, Magma ocean cumulate overturn: Generation of an early crust, Second Conference on Early Mars: Geologic, hydrologic, and climatic evolution and implications for life, Jackson Hole WY, October 2004.
37. Draper D., L.T. Elkins-Tanton, J. Jewell, A. Thrope, C. Agee, High Volatile Content and Shallow Melting at the end of the Siberian Flood Basalts: Experimental Results, American Geophysical Union Abstracts, Fall Meeting, 2004.
38. Elkins-Tanton L.T., Lithospheric Delamination as a Process to Introduce Water Into the Mantle, American Geophysical Union Abstracts, Fall Meeting, 2004.
39. Zaranek S., L.T. Elkins-Tanton, E. Parmentier, Magma Ocean Overturn: Implications for The Creation of Large Scale Mantle Heterogeneities and Influences on Planetary Evolution, American Geophysical Union Abstracts, Fall Meeting, 2004.
40. Cagnioncle, A., E. Parmentier, L.T. Elkins-Tanton, The Effect of Solid Mantle Flow Above a Subducting Plate on Melting and Fluid Migration, American Geophysical Union Abstracts, Fall Meeting, 2004.
41. Elkins-Tanton L.T., P.C. Hess, S.E. Smrekar, and E.M. Parmentier, Volcanism and volatile recycling on Venus from lithospheric delamination, Lunar and Planetary Science Conference XXXVI Abstracts, March 2005.
42. Elkins-Tanton L.T. and E. M. Parmentier, The fate of water in the Martian magma ocean and the formation of an early atmosphere, Lunar and Planetary Science Conference XXXVI Abstracts, March 2005.