

CURRICULUM VITA

January 2020

Edgar M. (Marc) Parmentier

Department of Earth Environmental and Planetary Sciences

Brown University

Providence, RI 02912

<https://www.brown.edu/academics/earth-environmental-planetary-sciences/about/faculty>

HOME

ADDRESS: 13 Biscuit Hill Road
Foster, RI 02825

EDUCATION:

B.S.	Engineering, Mathematics	West Virginia University	1967
M.Eng.	Engineering	Cornell University	1969
Ph.D.	Geophysics	Cornell University	1975

Dissertation topic: Studies of Thermal Convection With Application to Convection in the Earth's Mantle

PROFESSIONAL APPOINTMENTS:

Research Scientist	AVCO-Everett Research Laboratory Everett, MA	1969-1972
Research Fellow	Department of Geology and Mineralogy Oxford University	1975-1977
Adjunct Research Scientist	Lamont-Doherty Geological Observatory Columbia University	1985-2005
Green Scholar	Institute of Geophysics and Planetary Physics Scripps Institution of Oceanography University of California at San Diego	1986
Brown University	Department of Geological Sciences Assistant Professor (Research), Associate Professor (Research), Associate Professor Professor Department Chair Emeritus Professor	September 1977 - June 1980 July 1980 - September 1980 September 1980 - December 1989 January 1990 – July 2018 July 1999 – June 2005 July 2018 - present

COMPLETED RESEARCH:

Publications:

- E. M. Parmentier and D. L. Turcotte, An explanation of the Pyroxene geotherm based on plume convection in the upper mantle: *Earth. Planet. Sci. Let.* 24, 209-212 (1974).
- E. M. Parmentier and K. E. Torrance, Kinematically consistent velocity fields for hydrodynamic calculations in curvilinear coordinates: *J. Comp. Phys.* 19, 404-417 (1975).
- E. M. Parmentier, D. L. Turcotte, and K. E. Torrance, Numerical experiments on the structure of mantle plumes: *J. Geophys. Res.* 80, 4417-4424 (1975).
- D. L. Turcotte and E. M. Parmentier, Thermal convection in the earth's mantle: in *Proc. 12th An. Meeting Soc. Eng. Sci.*, 661-668, Univ. of Texas, Austin, Texas (1975).
- E. M. Parmentier, D. L. Turcotte and K. E. Torrance, Studies of finite amplitude non-Newtonian thermal convection with application to convection in the earth's mantle, *J. Geophys. Res.* 81, 1839-1846 (1976).
- D. E. Karig, J. G. Caldwell, and E. M. Parmentier, Effects of accretion on the geometry of the descending lithosphere, *J. Geophys. Res.* 81, 6281-6291 (1976).
- E. R. Oxburgh and E. M. Parmentier, Compositional and density stratification in the oceanic lithosphere - causes and consequences, *J. Geol. Soc. Lond.* 133, 343-354 (1977).
- E. R. Oxburgh and E. M. Parmentier, Thermal processes in the formation of continental lithosphere, *Phil. Trans. Roy. Soc. Lond.* A288, 415-429 (1978).
- E. M. Parmentier, A Study of thermal convection in non-Newtonian fluids, *J. Fluid Mech.* 84, 1-11 (1978).
- E. M. Parmentier and E. T. C. Spooner, A theoretical study of hydrothermal convection and the origin of the ophiolitic sulphide ore deposits of Cyprus, *Earth Planet. Sci. Let.* 40, 33-44 (1978).
- E. M. Parmentier and D. L. Turcotte, Two dimensional mantle flow beneath a rigid, accreting lithosphere, *Physics of the Earth and Planetary Interiors* 17, 281-289 (1978).
- E. M. Parmentier and J. E. Oliver, A study of shallow mantle flow due to the accretion and subduction of lithospheric plates, *Geophysical Journal of the Royal Astron. Soc.* 57, 1-2 (1979).
- E. M. Parmentier, Two phase natural convection adjacent to a vertical heated surface in a permeable medium, *Int. J. Heat Mass. Trans.* 22, 849-855 (1979).
- E. M. Parmentier and J. W. Head, Internal processes affecting surface of low-density satellites: Ganymede and Callisto, *J. Geophys. Res.* 84, 6263-6276 (1979).
- E. M. Parmentier and J. W. Head, Some possible effects of solid state deformation on the thermal evolution of ice-silicate planetary bodies, *Proceedings of the Tenth Lunar and Planetary Science Conference. Geochemica et Cosmochemica Acta, Suppl.* 11, 2403-2419 (1979).
- E. M. Parmentier, The pathline concept in application to the study of transport processes in hydrothermal systems, *Am. J. Sci.* 280, 826-829 (1980).
- P. Helfenstein and E. M. Parmentier, Fractures on Europa: Possible response of an ice crust to tidal deformation, *Proceedings of the Eleventh Lunar and Planetary Science Conference, 1987-1998* (1980).
- E. M. Parmentier and A. D. Schedl, Thermal aureoles of igneous intrusions: Some possible indications of hydrothermal convective cooling, *Jour. of Geology* 89, 1-22 (1981).
- E. M. Parmentier, A possible mantle instability due to superplastic deformation associated with phase transitions, *Geophysical Research Letters* 8, 143-146 (1981).
- E. M. Parmentier, Numerical experiments on ¹⁸O-depletion in igneous intrusion cooling by groundwater convection, *Jour. Geophys. Res.* 86, 7131-7144 (1981).
- E. M. Parmentier and J. W. Head, Viscous relaxation of impact craters on icy planetary surfaces: Determination of viscosity variation with depth, *Icarus* 47, 100-111 (1981).
- E. M. Parmentier, S. W. Squyres, J. W. Head, and M. L. Allison, The tectonics of Ganymede, *Nature* 295, 290-293 (1982).

- K. L. Nagy and E. M. Parmentier, Oxygen isotopic exchange at an igneous intrusive contact, *Earth Planet. Sci. Lett.* 59, 1-10 (1982).
- E. M. Parmentier and J. Morgan III, Thermal convection in non-Newtonian fluids volumetric heating and boundary layer scaling, *Jour. Geophys. Res.* 87, 7757-7762 (1982).
- P. Helfenstein and E. M. Parmentier, Patterns of fracture and tidal stresses on Europa, *Icarus* 53, 415-430 (1983).
- M. T. Zuber and E. M. Parmentier, A geometric analysis of surface deformation: Implications for the tectonic evolution of Ganymede, *Icarus* 60, 200-210 (1984).
- J. Phipps Morgan and E. M. Parmentier, Lithospheric stress near a ridge-transform intersection, *Geophys. Res. Lett.*, 11, 113-116 (1984).
- M. T. Zuber and E. M. Parmentier, Lithospheric stresses due to radiogenic heating of an ice-silicate planetary body: implications for Ganymede's tectonic evolution, *Jour. Geophys. Res.* 89, B429-B437 (1984).
- R.A.F. Grieve and E. M. Parmentier, Impact phenomena as factors in the evolution of the earth, *Proceedings of the 27th International Geological Congress*, 19, 99-114 (1984).
- E. M. Parmentier and D. W. Forsyth, Three dimensional flow beneath a slow spreading ridge axis: a dynamic contribution to the deepening of the median valley toward fracture zones, *Jour. Geophys. Res.* 90, 678-684 (1985).
- P. Helfenstein and E. M. Parmentier, Patterns of fracture and tidal stresses due to nonsynchronous rotation: implications for fracturing on Europa, *Icarus* 61, 175-184 (1985).
- J. Lin and E. M. Parmentier, Surface topography due to convection in a variable viscosity fluid: application to short wavelength gravity anomalies in the central Pacific Ocean, *Geophys. Res. Lett.* 12, 357-360 (1985).
- J. Phipps Morgan and E. M. Parmentier, Causes and rate limiting mechanisms of ridge propagation: a fracture mechanics model, *Jour. Geophys. Res.* 90, 8603-8612 (1985).
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- M. T. Zuber, E.M. Parmentier, and R. C. Fletcher, Extension of continental lithosphere: a model for two scales of Basin and Range deformation, *Jour. Geophys. Res.* 91, 4826-4838 (1986).
- M. T. Zuber and E. M. Parmentier, Lithospheric necking: a dynamic model for rift morphology, *Earth Planet. Sci. Lett.* 77, 373-383 (1986).
- W. R. Buck and E. M. Parmentier, Convection beneath young oceanic lithosphere: implications for thermal structure, and gravity, *Jour. Geophys. Res.* 91, 1961-1974 (1986).
- E. M. Parmentier and W. F. Haxby, Thermal stresses in the oceanic lithosphere: evidence from geoid anomalies at fracture zones, *Jour. Geophys. Res.* 91, 7193-7204 (1986).
- B.-Y. Kuo, D. W. Forsyth, and E. M. Parmentier, Flexure and thickening of the lithosphere at the East Pacific Rise, *Geophys. Res. Lett.* 13, 681-684 (1986).
- E.M. Parmentier, Dynamic topography in rift zones: implications for lithospheric heating, *Phil. Trans. R. Soc. Lond.* A321, 23-25 (1987).
- J. Phipps Morgan and E. M. Parmentier, A three-dimensional gravity study of the 95.5W propagating rift in the Galapagos Spreading Center, *Earth Planet Sci. Lett.* 81, 289-298 (1987).
- J. Phipps Morgan, E. M. Parmentier, and J. Lin, Mechanisms for the origin of mid-ocean ridge axial topography, *Jour. Geophys. Res.* 92, 12823-12836 (1987).
- J. Lin and E.M. Parmentier, Quasistatic propagation of a normal fault: a fracture mechanics model, *Jour. Structural Geology* 10, 249-262 (1988).
- W.F. Haxby and E.M. Parmentier, Thermal contraction and the state of stress in the oceanic lithosphere, *Jour. Geophys. Res.* 93, 6419-6429 (1988).
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- E.M. Parmentier and G.Schubert, Rift propagation, *Geophys. Res. Lett.* 16, 183-186 (1989).

- C. Sotin and E.M. Parmentier, On the stability of a fluid layer containing a univariant phase transition: application to planetary interiors, *Phys. Earth Planet. Int.* 55, 10-25 (1989).
- C. Sotin and E.M. Parmentier, Dynamical consequences of thermal and compositional density stratification beneath spreading centers, *Geophys. Res. Lett.* 16, 835-838 (1989).
- M.T. Zuber and E.M. Parmentier, On the relationship between isostatic elevation and the wavelengths of tectonic surface features on Venus, *Icarus* 85, 290-308 (1990).
- J. Lin and E.M. Parmentier, A finite amplitude necking model of rifting in brittle lithosphere, *Jour. Geophys. Res.* 95, 4909-4923 (1990).
- D.L. Bindschadler and E.M. Parmentier, Mantle flow tectonics: the influence of a ductile lower crust and the formation of topographic uplands on Venus, *Jour. Geophys. Res.* 95, 21329-21344 (1990).
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- E.M. Parmentier, C. Sotin, and B.J. Travis, Turbulent 3-D thermal convection in an infinite Prandtl number, volumetrically heated fluid: implications for mantle dynamics, *Geophys. J. Int.* 116, 241-251 (1994).
- D.L. Herrick and E.M. Parmentier, Episodic Large-Scale Overturn of Compositionally Stratified Mantles in Terrestrial Planets, *J. Geophys. Res.* 99, 2053-2062 (1994).
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- J.W. Head, E.M. Parmentier, and P.C. Hess, Venus: vertical accretion of crust and depleted mantle and implications for geological history and processes, *Planet. Space Sci.* 42, 803-811 (1994).
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- G. Choblet and E.M. Parmentier, Mantle upwelling and melting beneath slow spreading centers: effects of variable rheology and melt productivity, *Earth Planet. Sci. Lett.* 184, 589-604 (2001).
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- C.E. Hall and E.M. Parmentier, The influence of grain size evolution on convective instability, G^3 , doi:10.1029/2002GC00308, (2003).
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- S.E. Zaranek and E.M. Parmentier, Convective cooling of an initially stably stratified fluid with temperature-dependent viscosity: Implications for the role of solid-state convection in planetary evolution, *J. Geophys. Res.* 109, B03409, doi:10.1029/2003JB002462 (2004).
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- E. M. Parmentier and M. T. Zuber, Early evolution of Mars with mantle compositional stratification or hydrothermal crustal cooling, *J. Geophys. Res.*, 112, E02007, doi:10.1029/2005JE002626 (2007).
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- E.M. Parmentier, L.T. Elkins Tanton, and P.C. Hess, Solid-liquid segregation during magma ocean solidification: implications for longterm planetary evolution, in preparation (2009).
- G. Choblet and E. M. Parmentier, Thermal convection heated both volumetrically and from below: implications for predictions of planetary evolution, *Physics of the Earth and Planetary Interiors* 173, 290-296 (2009).
- A.-M. Cagnioncle, E.M. Parmentier, A.E. Saal, U-series systematics at convergent margins, in preparation (2009).
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- Nan Zhang, E. M. Parmentier, Yan Liang, A 3-D numerical study of the thermal evolution of the Moon after cumulate mantle overturn: The importance of rheology and core solidification, *Journal of Geophysical Research: Planets* 118,1789–1804, (2013). DOI: 10.1002/jgre.20121.
- Nan Zhang, E. M. Parmentier, Yan Liang, Effects of lunar cumulate mantle overturn and megaregolith on the expansion and contraction history of the Moon, *Geophysical Research Letters* 40, 5019–5023 (2013). DOI: 10.1002/grl.50988.
- C. Havlin, E. M. Parmentier, Implications for melt transport and source heterogeneity in upwelling mantle from the magnitude of Sp converted phases generated at the onset of melting, *Geophysical Research Letters* 41, 5444–5450 (2014). DOI: 10.1002/2014GL060890.
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- F. Clerc, M. D. Behn, E. M. Parmentier, G. Hirth (2018), Predicting Rates and Distribution of Carbonate Melting in Oceanic Upper Mantle: Implications for Seismic Structure and Global Carbon Cycling, *Geophysical Research Letters* 45, 6944-6953, doi.org/10.1029/2018GL078142.
- C.E. Boukaré, E.M. Parmentier, and S. Parman (2018) Timing of mantle overturn during magma ocean solidification, *Earth and Planetary Science Letters* 491, 216-225.
- C.E. Boukaré, S.W. Parman, E.M. Parmentier, B.A. Anzures (2019) Production and preservation of sulfide layering in Mercury's mantle, *Journal of Geophysical Research: Planets* doi.org/10.1029/2019JE005942.

UNIVERSITY SERVICE:

1999-05	Department Chair
2006-07	Departmental Colloquium Committee
2007-08	Departmental Curriculum Committee
2008-14	Departmental Director of Graduate Studies

PROFESSIONAL SERVICE:

Reviews of papers and proposals

Organizer of special session: Geological Processes on Icy Planetary Bodies,
1981 Annual Spring Meeting of the American Geophysical Union.

Team member: Basaltic Volcanism Study Project
Tectonics of Basaltic Volcanism, Chapter 6,
Basaltic Volcanism on the Terrestrial Planets,
Pergamon Press (1981).

NASA Planetary Geophysics and Geochemistry Program
Planetary Geosciences Review Panel, 1983-85
Program Chair, Tectonophysics Section
American Geophysical Union Annual Spring Meeting, 1984-85.

NASA Planetary Geology and Geophysics Working Group, 1985-present
Chairperson 1987-present

Ridge InterDisciplinary Global Experiment (RIDGE) Planning Study, 1987-1990
Co-Chairperson, Theoretical, Experimental, and Analytical
Development Working Group

American Geophysical Union:

President Tectonophysics Section, 1992 - 1994
 Audit and Legal Affair Committee (chair), 1992-1995
 Whitten Medalist Selection Committee (chair), 1994-1996
 Nominations Committee, 1996-1997
 JGR Editorial Search Committee (chair), 1998-1999
 Fellows Committee, 2001-3

European Geophysical Union:

Love Medal Selection Committee, 2018-2019

NASA Planetary Geosciences Program

Planetary Geosciences Review Panel, 1992

Venus Data Analysis Program Review Panel (geophysics chairperson), 1992

Planetary Geosciences Review Panel (geophysics chairperson), 2000

NSF Graduate Fellowship Application Review Panel, 1994

NSF Future of Marine Geosciences - invited review paper and speaker, 1996

New Views of the Moon – workshop organizer, chapter editor, and author, 2000-2002

Harvard University, Department of Earth Sciences Visiting Committee, 2002 - present

Mantle Dynamics Workshop – Boulder, CO Summer 2005 - workshop co-organizer

NSF Computational Infrastructure in Geodynamics – Science Steering Committee Chair 2005-2006
 Executive Committee, vice chair 2009-2010.
 Executive Committee, chair 2010-2013.

NSF High Performance Computing in the Geosciences – invited participant – September 2006

NSF Marine Geosciences Proposal Review Panel member – November 2006

Harvard University, Department of Earth Sciences Interim Visiting Committee, December 2008

NSF Margins Program Decadal Review Panel member – February 2009.

NSF Earth Sciences CSEDI proposal review panel – February 2010.

ACADEMIC HONORS:

Tau Beta Pi	1968
National Science Foundation Graduate Fellow	1967-68
Ford Foundation Fellow	1967-68
Green Fellow	1985
American Geophysical Union Fellow	elected 1995
EGU A.E.H. Love medal recipient	2017

RESEARCH GRANTS (last five years):

High-order accurate numerical models of melt migration beneath mid-ocean ridges (co-PI)

Co-PI with Yan Liang

NSF Ocean Sciences, Marine Geology and Geophysics Program

Amount: \$409,541. Duration: 6/12-6/15

Layering within cratonic lithosphere: Integrated constraints from xenoliths, seismic structure and geodynamical modeling;

Co-PI with Fischer, Dalton, Hirth, and Saal

NSF Earth Sciences – Studies of Earth's Deep Interior

Amount: \$519,493 Duration: 6/14-6/16

Investigating the mantle expression of continental strike-slip fault systems with scattered wave imaging of the lithosphere-asthenosphere boundary

Co-PI with K. Fischer

NSF Earth Sciences – Geophysics

Amount: \$231,291

Duration: 7/15/14-6/30/16

Evolution and Environment of Exploration Destinations: Science and Engineering Synergism

Co-PI with C. Pieters, et al.

NASA

Amount: \$5,552,998

Duration: 3/14-3/19

Primary differentiation of Mercury's interior

Co-PI with S. Parman

NASA Early Solar System

Amount: \$609,512

Duration: 24 months

TEACHING (last five academic years):

- | | |
|-----------|---|
| 2010-2011 | Geological Sciences 0250 Computational Approaches to Modelling and Quantitative Analysis in the Natural Sciences: an Introduction
Geological Sciences 1620 Continuum Physics of the Solid Earth |
| 2011-2012 | Geological Sciences 0250 Computational Approaches to Modelling and Quantitative Analysis in the Natural Sciences: an Introduction
Geological Sciences 2920 Melt and fluid migration (with Yan Liang) |
| 2012-2013 | Geological Sciences 0250 Computational Approaches to Modelling and Quantitative Analysis in the Natural Sciences: an Introduction
Geological Sciences 1620 Continuum Physics of the Solid Earth |
| 2013-2014 | Geological Sciences 0250 Computational Approaches to Modelling and Quantitative Analysis in the Natural Sciences: an Introduction
Geological Sciences 2520 Numerical Geodynamics |
| 2014-2015 | Geological Sciences 0250 Computational Approaches to Modelling and Quantitative Analysis in the Natural Sciences: an Introduction |
| 2015-2016 | Geological Sciences 1620 Continuum Physics of the Solid Earth
Geological Sciences 2920 Magma oceans and planetary evolution (with S. Parman) |
| 2016-2017 | Geological Sciences 0250 Computational Approaches to Modelling and Quantitative Analysis in the Natural Sciences: an Introduction
Geological Sciences 2920 Mantle melt migration at oceanic spreading centers (with C. Dalton) |
| 2017-2018 | Geological Sciences 1620 Continuum Physics of the Solid Earth |

RESEARCH SUPERVISION AND MENTORSHIP:

Graduate student mentorship/research supervision:

- Paul Helfenstein (1/79-9/81): Patterns of fracture and tidal stresses on Europa, M.Sc. 1982.
- J. Gephart (6/81 - 6/86, with D.W. Forsyth): Studies of stress and deformation in the Earth's crust, Ph.D. 1986.
- M. T. Zuber (6/80 - 6/86): Unstable deformation in layered media: application to planetary lithospheres, Ph.D. 1986.
- J. Phipps Morgan (6/81 - 6/86): The dynamics of midocean ridges, Ph.D. 1986.
- Jian Lin (6/82 - 9/88): Surface topography due to convection in a variable viscosity fluid, M.Sc.1984; Mechanisms of non-elastic extension of lithospheres, Ph.D. 1988.
- Grant Marshall (9/87 - 9/89): Convective instabilities within a horizontally extending or shortening thermal boundary layer, M.Sc. 1989.
- David Herrick (9/89 - 8/91): Episodic evolution of two-layer mantles in terrestrial planets, M.Sc. 1991.
- David Sparks (1/87 - 5/92): Mantle flow and the generation and segmentation of magma beneath spreading centers, Ph.D. 1992.
- Jonathan Kaufman (9/92 - 8/94): The fixity and longevity of hotspots: a consequence of plumes in a mantle with temperature dependent viscosity?, M.Sc. 1994.
- Kopal Jha (6/91-1/96) Mantle convection beneath ridges and rifts, Ph.D. 1996.
- Kerry Alley (9/94-8/96) - Numerical experiments on thermal convection in a chemically stratified viscous fluid heated from below: implications for a model of lunar evolution, M.Sc. 1997.
- Peter Leth (1/97-8/00) – On the linearity of small-scale convective instabilities: Implications for intrplate volcanism and gravity lineations, M.Sc. 2000.
- Chad Hall (9/96-8/01) – The physics of deformation processes in mantle dynamics – Ph.D. 2001.
- Jennifer Rilling (9/01-8/03) – Fluid migration and melting at converging plate boundaries – M.Sc. 2003.
- Daynathie Weeraratne (9/01-9/06) - Behavior of asthenosphere beneath oceans and continents - Ph.D. 2004.
- Lydia Burroughs (9/01-6/04) - Thermal stresses and global scale ridges on Mars - M.Sc. 2004.
- Sarah Zaranak (9/99-6/05) – Convective instability and planetary evolution – Ph.D. 2005
- Amandine Cagnioncle (9/03-9/09) – Characterizing fluid migration and melt production at convergent plate boundaries – Ph.D. 2009
- McCall Bureau (1/08-12/11)
- Christopher Havlin (9/09-5/14)
- Conroy Baltzell (9/12-present)

Post-doctoral research mentorship:

- L.T. Elkins-Tanton (2003-2007)
- Nan Zhang (2012-2013)
- C.E. Boukaré (2017-2019)

External thesis examiner:

- W.R. Buck, Massachusetts Institute of Technology, 1984
- P. Thomas, Monash University, 1986
- L. Sonder, Harvard University, 1986
- M. Gurnis, Australian National University, 1986
- E. Robinson, Massachusetts Institute of Technology, 1987
- Pal Wessel, Columbia University, 1989

M. Cordery, Massachusetts Institute of Technology, 1990
L. Dupeyrat, University of Paris, 1993
Gael Choblet, Universite de Nantes, France, 1999
Laurent Montesi, Massachusetts Institute of Technology, 2001
Jacqueline Floyd, Columbia University, 2003
Ran Qin, Columbia University, 2007