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Research interest

I use the tool of geodynamic modeling, in collaboration with seismologists, geochemists, petrologists and mineral physicists to investigate the Earth's thermal and compositional evolution, the nature of mantle convection, and its links to surface observations. I am also interested in understanding how other solar and extrasolar planets evolve differently than Earth. I also enjoy developing methods and writing codes to apply to important, unexplored science questions.

Education

Ph.D. Geological Sciences, Arizona State University, 2010-2015

M.S. Geophysics, Institute of Geology and Geophysics, Chinese Academy of Sciences, 2007-2010

B.S. Geophysics, Yunnan University, 2003-2007

Employment

08/2017 – Now: Assistant Professor at Arizona State University

07/2015 – 07/2017: Postdoc Research Associate at University of Colorado Boulder

01/2015 – 06/2015: Research Professional at Arizona State University

2011-2014: Teaching Assistant at Arizona State University

2010-2014: Research Associate at Arizona State University

Teaching

SES 494/591 The Dynamic Planets, 2017 fall

GLG 418 Geophysics, 2011 fall, 2012 fall, 2013 fall, 2014 fall (TA)

GLG598 Numerical Methods, 2014 spring (TA)

GLG 419 Geodynamics, 2013 spring (TA)

Awards

2014 Outstanding Graduate Teaching Assistant

2014 Graduate Excellence Award

2013 AGU Outstanding Student Paper Award

Publications:

Li, M., and McNamara, A.K., 2017. The influence of evolving morphology of compositional heterogeneity in the lowermost mantle on Earth's thermal evolution, *Earth Planet. Sci. Lett.*, in review.

Li, M., and S. Zhong, 2017. Linking lowermost mantle structure, core-mantle boundary heat flux and mantle plume formation, *Physics of Earth and Planetary Interiors*, in revision.

Li, M., and S. Zhong, 2017. The source location of mantle plumes from 3D spherical models of mantle convection, *Earth Planet. Sci. Lett.*, 478, 47-57.

Li, M., McNamara, A.K., Garnero, E.J., Yu, S., 2017. Compositionally-distinct ultra-low velocity zones on Earth's core-mantle boundary. *Nature Communications* 8, 177.

Frost, D.A., Rost, S., Garnero, E.J., and **Li, M.** Seismic evidence for Earth's crusty deep mantle, *Earth and Planetary Science Letters*, 470, 54-63.

Zhao, C. P., E. J. Garnero, **M. Li**, A. McNamara, and S. L. Yu (2017), Intermittent and lateral varying ULVZ structure at the northeastern margin of the Pacific LLSVP, *Journal of Geophysical Research-Solid Earth*, 122(2), 1198-1220.

Li, M., Black, B., Zhong, S., Manga, M., Rudolph, M.L. and Olson, P., 2016. Quantifying melt production and degassing rate at mid-ocean ridges from global mantle convection models with plate motion history. *Geochemistry, Geophysics, Geosystems*, 17: 2884-2904.

Gu, T., **Li, M.**, McCammon, C. and Lee, K.K.M., 2016. Redox-induced lower mantle density contrast and effect on mantle structure and primitive oxygen. *Nature Geoscience*, 9: 723-727.

Zhang, Z., Dorfman, S.M., Labidi, J., Zhang, S., **Li, M.**, Manga, M., Stixrude, L., McDonough, W.F. and Williams, Q., 2016. Primordial metallic melt in the deep mantle. *Geophysical Research Letters*, 43(8): 3693-3699.

Li, M., 2015, Thermochemical Structure and Dynamics of Earth's Lowermost Mantle, PhD dissertation.

Williams, C.D., **Li, M.**, McNamara, A.K., Garnero, E.J. and van Soest, M.C., 2015. Episodic entrainment of deep primordial mantle material into ocean island basalts. *Nature Communications*, 6: 8937.

Li, M., McNamara, A.K. and Garnero, E.J., 2014. Chemical complexity of hotspots caused by cycling oceanic crust through mantle reservoirs. *Nature Geoscience*, 7(5): 366-370.

Cottaar, S., **Li, M.**, McNamara, A.K., Romanowicz, B. and Wenk, H.-R., 2014. Synthetic seismic anisotropy models within a slab impinging on the core-mantle boundary. *Geophysical Journal International*, 199(1): 164-177.

Li, M. and McNamara, A.K., 2013. The difficulty for subducted oceanic crust to accumulate at the Earth's core-mantle boundary. *J. Geophys. Res.*, 118(4): 1807-1816.

Li, M. and He, Y.M., 2011. Lithospheric structure beneath northeastern boundary region of the North China Craton from Rayleigh wave dispersion inversion. *Acta Seismologica Sinica*, 33(2): 143-155.

Invited Presentations (first author)

- 2017 GRC conference (coming), Key Speaker, “Evolving morphology and distribution of compositional heterogeneities in the lowermost mantle”
- 2017 March, research seminar at Stony Brook University
- 2017 March, research seminar at Princeton University
- 2015 AGU, “Evolving morphology of thermochemical piles caused by accumulation of subducted oceanic crust”
- 2014 AGU, “Interaction Between LLSVPs and ULVZs and Its Implication for the Origin of ULVZs”
- 2014 AGU, “Interaction Between Mantle Plumes, Subducted Oceanic Crust and Primordial Reservoirs at Earth’s Lowermost Mantle”
- 2014 Astrobiology group at Arizona State University, “The fate of subducted oceanic crust”
- 2013 summer at Institute of Geology and Geophysics, Chinese Academy of Sciences, “The effects of subducted oceanic crust on chemical heterogeneity of the lowermost mantle”

Conferences

2017

- Li, M., S., Zhong., On the lateral motion of mantle plumes from 3D models of mantle convection with plate motion history, 2017 AGU.
- Lee, K.K.M, T. Gu, N. Creasy, M. Li, C. McCammon, Facilitating atmosphere oxidation through mantle convection, 2017 Goldschmidt.
- McNamara, A.K., M. Li, E.J. Garnero, and N. Marin, understanding how the shape and spatial distribution of ULVZs provides insight into their cause and to the nature of global-scale mantle convection, 2017 EGU.
- GRC conference (coming). **Key Speaker.** Evolving morphology and distribution of compositional heterogeneities in the lowermost mantle

2016

- Ko., B., A., Holt, C., Gao, D., Frost, H., Karaoglu, H., Lai, K., Yuan, M., Li, S.M., Campbell, S.H., Shim, J., Irving, L.H., Kellogg, M.S., Miller, Probing the lower mantle composition and thermal structure: Insights from D”, 2016 AGU.

- Rudolph, M., M., Li., S., Zhong, and M., Manga, Mantle mixing and thermal evolution during Pangaea assembly and breakup, 2016 AGU.
- Li., M., and S., Zhong, The Source and Lateral Motion of Mantle Plumes from 3D Mantle Dynamic Models, 2016 AGU.

2015

- McNamara, A.K., M. Li, and E.J. Garnero, Ultra-low velocity zone (ULVZ) locations provide insight into their cause and global-scale convection patterns, 2015 Goldschmidt.
- McNamara, A., M. Li, and E. Garnero, ULVZ locations can provide insight into their cause, 2015 IUGG General Assembly.
- Li, M., B. Black, S. Zhong, M. Manga, M. L. Rudolph, and P. Olson, Quantifying global melt flux and degassing rate from global mantle convection models with plate motion history, 2015 AGU.
- Li, M., and A.K., McNamara, Evolving morphology of thermochemical piles caused by accumulation of subducted oceanic crust, 2015 AGU.

2014

- de Silva, S., V., Finlayson, T., Gu, M., Li, C.R., Lithgow-Bertelloni, and V.F., Cormier, Modeling Mantle Heterogeneity Development in Earth's Mantle Using Multidisciplinary Approaches, 2014 AGU.
- McNamara, A., M. Li, C. Williams, E. Garnero, and M. Van Soest, The interaction of subducted oceanic crust with long-lived compositional reservoirs in the deep mantle, Goldschmidt, 2014.
- Cottaar, S., M., Li, A.K., McNamara, B.A., Romanowicz and H.R., Wenk, The Role of Post-Perovskite in Explaining Observations of Seismic Anisotropy, 2014 AGU.
- Waszek, L., K., Arredondo, G.J., Finkelstein, L.H., Kellogg, V., Lekic, M., Li, C.R., Lithgow-Bertelloni, B.A., Romanowicz, N.C., Schmerr, M.L., Ruldoph, J.P., Townsend, Z., Xing and F., Yang, Slab Stagnation in the Lower Mantle: A Multidisciplinary Investigation, 2014 AGU.
- Li, M., A.K., McNamara, and E.J., Garnero, Interaction Between LLSVPs and ULVZs and Its Implication for the Origin of ULVZs, 2014 AGU.
- Li, M., A.K., McNamara, and E.J., Garnero, Interaction Between Mantle Plumes, Subducted Oceanic Crust and Primordial Reservoirs at Earth's Lowermost Mantle, 2014 AGU.
- Li, M., and A.K., McNamara, Investigating Potential Causes for an Abrupt Change of Thermal State in Earth's Upper Mantle During the Great Oxygenation Event, 2014 AGU.
- Li, M., A.K., McNamara, and E.J., Garnero, Investigating the origin of ultra-low velocity zones, 2014 Goldschmidt.

2013

- McNamara, A.K., M. Li, C. Williams, and E.J. Garnero, Investigating the Interaction Between Long-lived Compositional Reservoirs and Subducted Oceanic Crust, 2013 AGU.

- McNamara, A.K., M., Li, C., Williams, and E.J., Garnero, Investigating the Interaction Between Long-lived Compositional Reservoirs and Subducted Oceanic Crust, 2013 AGU.
- Cottaar, S., M., Li, A.K., McNamara, B.A., Romanowicz and H.R., Wenk, Splitting predictions for synthetic anisotropy models in the lowermost mantle beneath a slab, 2013 AGU.
- Li, M., A.K., McNamara, and E.J., Garnero, Three dimensional morphology and dynamics of ultra-low velocity zones, 2013 AGU.
- Li, M., A.K., McNamara, and E.J., Garnero, Episodic Entrainment of Subducted Oceanic Crust into Primordial Reservoirs of the Lower Mantle, 2013 Gordon Conference.

2011-2012

- Cottaar, S., M. Li, L.M. Miyagi, A.K. McNamara, B.A. Romanowicz, and H.-R. Wenk, Forward modeling the perovskite-postperovskite transition in seismically anisotropic models beneath a slab, 2012 AGU.
- Li, M., A.K., McNamara, and E.J., Garnero, Episodic Entrainment of Subducted Oceanic Crust into Primordial Reservoirs of the Lower Mantle, 2012 AGU.
- Li, M. and A.K., McNamara, The Difficulty for Subducted Oceanic Crust to Accumulate at the Core-Mantle Boundary, 2011 AGU.

Projects

- NSF-EAR, An investigation into the compositionally heterogeneous plume clusters in 3D spherical geometry
- NSF-EAR, Investigating the cause and significance of Ultra Low Velocity Zones.
- NSF-EAR, Cooperative Studies of the Earth's Deep Interior (CSEDI): a multidisciplinary approach to investigate the origin of seismic anisotropy at the base of the mantle.
- NSF, Frontiers in Earth System Dynamics (FESD) Type I: The Dynamics of Earth System Oxygenation.
- NSF, FESD Type I: Open Earth Systems: Whole planet models for global processes and major events in Earth's history.

Services and outreaching

- Associate Editor for Geophysical Research Letter from 06/06/2017 to 12/31/2019.
- 2017 AGU. Session Chair and Primary convener: Deep Mantle Dynamics and Its Surface Expressions.
- 2015 AGU. Session Chair: Properties, Structure, and Dynamics of the Earth's Lower Mantle.
- Group meeting organizer at Arizona State University and University of Colorado Boulder.

- Donate images to German school children's magazine floh!
- Reviewer for journals including Geology, EPSL, JGR, GRL, Nature Geoscience, PEPI, Lithos.
- Reviewer for NSF proposal