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Research interest

I use the tool of geodynamic modeling, in collaboration with researchers from other fields (i.e., seismology, geochemistry, petrology and mineral physics) to investigate the Earth's thermal and compositional evolution, the nature of mantle convection, and their links to surface observations. I am also interested in understanding how other solar and extrasolar planets evolve differently than Earth. I develop methods and write codes to apply to important, unexplored science questions. My research interests are mainly focused on the following topics:

- Linking mantle dynamics, surface volcanism and plate tectonics
- Structure and dynamics of the solid Earth
- Early evolution of the Earth
- Structure, dynamics and evolution of other solar and extrasolar planets

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

From 08/2017: 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

Publications (peer-reviewed):

(2021)

- 21 Li, M. (2021), The cycling of subducted oceanic crust in the Earth's deep mantle, Book Chapter in "Mantle Convection and Surface Expressions", AGU Geophysical Monograph Series, in press.

- 20 Wang, Y., and M. Li (2021), The interaction between mantle plumes and lithosphere and its surface expressions: 3-D numerical modelling, *Geophysical Journal International*, doi:10.1093/gji/ggab014.

(2020)

- 19 Wang, Y., and M. Li (2020), Constraining Mantle Viscosity Structure From a Statistical Analysis of Slab Stagnation Events, *Geochemistry, Geophysics, Geosystems*, 21(11), e2020GC009286, doi:10.1029/2020gc009286.
- 18 Li, M. (2020), The Formation of Hot Thermal Anomalies in Cold Subduction - Influenced Regions of Earth's Lowermost Mantle, *Journal of Geophysical Research: Solid Earth*, 125(6), e2019JB019312, doi:10.1029/2019jb019312.

(2019)

- 17 Li, M., and S. Zhong (2019), Lateral Motion of Mantle Plumes in 3 - D Geodynamic Models, *Geophysical Research Letters*, 46(9), 4685-4693, doi:10.1029/2018gl081404.
- 16 Wang, Y., Pavlis, G. L. & Li, M., 2019, Heterogeneous distribution of water in the mantle transition zone inferred from wavefield imaging. *Earth Planet. Sci. Lett.* **505**, 42-50, doi:10.1016/j.epsl.2018.10.010.

(2018)

- 15 Li, M., Zhong, S. J. & Olson, P., 2018, Linking lowermost mantle structure, core-mantle boundary heat flux and mantle plume formation. *Phys. Earth Planet. Int.* 277, 10-29.
- 14 Li, M. & McNamara, A. K., 2018, The influence of deep mantle compositional heterogeneity on Earth's thermal evolution. *Earth Planet. Sci. Lett.* 500, 86-96.
- 13 Chandler, B. C., Yuan, K., Li, M., Cottaar, S., Romanowicz, B., Tomé, C. N. & Wenk, H. R. A., 2018, Refined Approach to Model Anisotropy in the Lowermost Mantle. *IOP Conference Series: Materials Science and Engineering* 375, 012002.

(2017)

- 12 Li, M. & Zhong, S., 2017, The source location of mantle plumes from 3D spherical models of mantle convection. *Earth Planet. Sci. Lett.* 478, 47-57.
- 11 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.
- 10 Zhao, C., Garnero, E. J., Li, M., McNamara, A. & Yu, S., 2017, Intermittent and lateral varying ULVZ structure at the northeastern margin of the Pacific LLSVP. *J. Geophys. Res.* 122, 1198-1220.
- 9 Frost, D. A., Rost, S., Garnero, E. J. & Li, M., 2017, Seismic evidence for Earth's crusty deep mantle. *Earth Planet. Sci. Lett.* 470, 54-63.

(2016)

- 8 Li, M. M., Black, B., Zhong, S. J., Manga, M., Rudolph, M. L. & Olson, P., 2016, Quantifying melt production and degassing rate at mid-ocean ridges from global mantle convection models with plate motion history. *Geochem. Geophys. Geosyst.* 17, 2884-2904.
- 7 Zhang, Z., Dorfman, S. M., Labidi, J., Zhang, S., Li, M., Manga, M., Stixrude, L., McDonough, W. F. & Williams, Q., 2016, Primordial metallic melt in the deep mantle. *Geophys. Res. Lett.* 43, 3693-3699.
- 6 Gu, T., Li, M., McCammon, C. & Lee, K. K. M., 2016, Redox-induced lower mantle density contrast and effect on mantle structure and primitive oxygen. *Nat. Geosci.* 9, 723-727.

(2015)

- 5 Williams, C. D., Li, M., McNamara, A. K., Garnero, E. J. & van Soest, M. C., 2015, Episodic entrainment of deep primordial mantle material into ocean island basalts. *Nat. Commun.* 6, 8937.

(2014)

- 4 Li, M., McNamara, A. K. & Garnero, E. J., 2014, Chemical complexity of hotspots caused by cycling oceanic crust through mantle reservoirs. *Nat. Geosci.* 7, 366-370.
- 3 Cottaar, S., Li, M., McNamara, A. K., Romanowicz, B. & Wenk, H.-R., 2014, Synthetic seismic anisotropy models within a slab impinging on the core–mantle boundary. *Geophys. J. Int.* 199, 164-177.

(2013)

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

(2011)

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

Invited Presentations (first author)

- 2018 December, AGU Fall meeting, “The distribution and advection of subducted oceanic crust in the Earth’s deep mantle”
- 2018 October, University of Arizona Colloquium, “Dynamics of mantle plumes: understanding the formation of hotspot tracks”
- 2018 March, Scripps Geophysics Seminar, “Dynamics of mantle plumes: understanding the formation of hotspot tracks”
- 2017 July, GRC conference, Key Speaker, “Evolving morphology and distribution of compositional heterogeneities in the lowermost mantle”

- 2017 March, research seminar at Stony Brook University, “Dynamics of mantle plumes: understanding the formation of hotspot tracks”
- 2017 March, research seminar at Princeton University, “Dynamics of mantle plumes: understanding the formation of hotspot tracks”
- 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

* indicates student presentations and **indicates postdoc presentations, under my supervision.

(2018)

- Li., M., & S., Zhong, Lateral motion of mantle plumes in 3D geodynamic models, 2018 AGU.
- Li., M., & A., McNamara, The distribution and advection of subducted oceanic crust in the Earth’s deep mantle, 2018 AGU.
- Wang**, Y., M., Li, Quantifying the interaction between mantle plumes and the lithosphere and their surface expressions, 2018 AGU.
- Allen*, W., M., Li, The effects of a low viscosity transition zone on mantle dynamics, 2018 AGU.
- Yu, S., E., Garnero, S.H., Shim, M., Li, Ultra-High Velocity Zones (UHVZs) at Earth’s core mantle boundary, 2018 AGU.
- Chandler, B.C., L., Chen, S., Cottaar, M., Li, A., McNamara, B., Romanowicz, H.R., Wenk, Exploring deformation mechanisms at the base of the Earth’s mantle with combined constraints from geodynamic, mineral physics, and seismic anisotropy, 2018 AGU.
- McNamara, A., M., Li., The Stirring and Accumulation of Oceanic Crust in the Mantle: How it Changes with Time? 2018 EGU.

(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. **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., Rudolph, 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.

Teaching

2021 Spring, Numerical methods

2020 Fall, Exploring data with Python

2020 Spring, Geodynamics

2019 Fall, GLG101 Introduction to geology

2019 Spring, Exploring data with Python

2018 Fall, GLG418/598 Geophysics

2018 Spring, GLG494/591 Dynamic topography and geoid (new class)

2017 Fall, SES 494/591 The Dynamic Planets, 2017 fall (new class)

Before 2017:

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

GLG598 Numerical Methods, 2014 spring (TA)

GLG 419 Geodynamics, 2013 spring (TA)

Students

Graduate: Qian Yuan (2018-), Camerian Millsaps (2018-)

Undergraduate: Weldyn Allen (2018 summer)

Postdoc: Yongming Wang (2018-)

Committee (9 students): Guang Zhai (2018 defended), Alejandro Lorenzo (2018 defended), Ruirui Han (2017, defended), Huawei Chen (ongoing), Hongyu Lai (ongoing), Chuhong Mai (ongoing), Shule Yu (ongoing), Byeongkwan Ko (ongoing), Susan Klem (ongoing).