

## Mingda Lyu (Lv)

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### Education

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**May 2021**, Ph.D. Geological Sciences, Michigan State University, MI, USA

Thesis: *Carbon and Nitrogen in Earth and Planetary Interiors*, Advisor: Susannah Dorfman

**June 2016**, M.Sc. Geochemistry, Peking University, Beijing, China

Thesis: *Crystal structure and spectroscopic study of Al<sub>2</sub>SiO<sub>5</sub> polymorphs*, Advisor: Xi Liu

**June 2013**, B.Sc. Geology, Sun Yat-Sen University, Guangzhou, China

Thesis: *Studies of geochemistry and geochronology of ore deposits using LA-ICP-MS*, Advisor: Xiaoming Sun

### Professional Appointments / Research Experience

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**6/2021-**, Postdoctoral Appointee, Argonne National Laboratory

**6/2021-**, Visiting Investigator, Earth & Planets Laboratory, Carnegie Institution for Science

Exploring the structural properties of materials under high pressure and temperature conditions in 3D, using X-ray diffraction-contrast computed tomography

**8/2016-5/2021**, Research Assistant, Michigan State University

Funded by NSF grant 1664332 CSEDI Collaborative Research: Chemistry and Dynamic Implications of Heterogeneous Fe and Si in the Deep Lower Mantle, NSF grant 1751664 CAREER: Experimental Constraints on Carbon-iron Redox Interaction in Earth's Deep Lower Mantle, and Sloan Foundation's Deep Carbon Observatory Grant G-2017-9954.

Headed high pressure and temperature experiments using synchrotron X-ray techniques, laser-heated diamond anvil cell, and electron microscopy techniques to explore physical and chemical properties of lower mantle and core materials; planning and designing experiments, writing beamtime proposals, developing data processing methods and software.

**9/2013-6/2016**, Research Assistant, Peking University

Headed high pressure and temperature experiments using multi-anvil press, piston cylinder, and electron microscopy techniques, and conducted first-principle calculations to explore physical and chemical properties of upper mantle materials.

**9/2012-6/2013**, Undergrad Thesis Research, Sun Yat-Sen University

Performed in-situ geochemical analysis of zircon U-Pb dating and trace elements using LA-ICP-MS and applied for ore deposits studies.

**Spring 2012**, Undergrad Visiting Fellow, National Cheng Kung University, (PI: Dr. Wei-Teh Jiang)

Learned orientation and microfabric analysis of clay minerals using SEM, TEM, and XRD.

**9/2011- 6/2013**, Undergrad Research Assistant, Sun Yat-Sen University, (PI: Dr. Yongzhang Zhou)

Performed order-degree, major elements, and trace elements analysis of siliceous rock using Raman, powder XRD, XRF, and ICP-MS.

## Teaching Experience

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### **Fall 2020**, GLG-321 “Mineralogy and Geochemistry”, Michigan State University, **Teaching Assistant**

Adapting mineralogy laboratory to online mode; teaching and grading 2 10-student sections of online mineralogy laboratory

### **Spring 2020**, GLG-201 “The Dynamic Earth”, Michigan State University, **Teaching Assistant**

Taught and graded 3 30-student sections of laboratory exercises for introductory geology in both in-person and online modes

## Academic Honors and Awards

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<b>2021</b>	Award for Graduate Research, Study of the Earth’s Deep Interior Section, American Geophysical Union
<b>2021</b>	John C. Jamieson Student Paper Award, Mineral and Rock Physics Section, American Geophysical Union
<b>2021</b>	Finalist, Morton K. Blaustein Postdoctoral Scholar, Department of Earth and Planetary Sciences, Johns Hopkins University
<b>2020</b>	Pringle Endowed Fellowship (\$1,400), Department of Earth and Environmental Sciences (EES), Michigan State University
<b>2018</b>	Alfred J. and Ruth Zeits Endowed Fellowship (\$8,000), College of Natural Science (CNS), Michigan State University
<b>2018</b>	Pringle Endowed Fellowship (\$1,500), EES, Michigan State University
<b>2017</b>	Student Best Presentation Award, Consortium for Materials Properties Research in Earth Sciences (COMPRES) Annual Meeting
<b>2017</b>	Neal Research Scholarship (\$1,800), EES, Michigan State University
<b>2016</b>	Geological Sciences Alumni Fellowship (\$17,000), EES, Michigan State University
<b>2016</b>	Outstanding Graduate (5%), Peking University
<b>2016</b>	Li Siguang Outstanding Student Award (¥10,000), Li Siguang Geological Science Award Foundation
<b>2016</b>	Second Prize in Graduates Academic Forum, Peking University
<b>2015</b>	National Scholarship (¥20,000), Ministry of Education of the People's Republic of China
<b>2015</b>	Innovation Award, Peking University
<b>2015</b>	Academic Scholarship of Geochemistry (¥10,000), Peking University
<b>2015</b>	Second Prize in Graduates Academic Forum, Peking University
<b>2014</b>	Excellence in Learning Award, Peking University
<b>2013</b>	“Genius to Know” Scholarship (¥5,000), Educational Foundation of CETV
<b>2013-2014</b>	Academic Scholarship (¥12,000*2), First Class, Peking University
<b>2013</b>	Outstanding Graduate (5%), Sun Yat-Sen University
<b>2011</b>	Silver Award in Scientific Investigation Competition (¥2,000), Sun Yat-Sen University
<b>2010-2012</b>	Academic Scholarship (¥1,000*3), Second Class, Sun Yat-Sen University

## Publications

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13. Frost, D. A., Avery, M. S., Buffett, B. A., Chidester, B. A., Deng, J., Li, Z., Liu, L., **Lv, M.**, Martin, J. F. (2021). Multidisciplinary constraints on the thermal-chemical boundary between Earth's core and mantle. *Geochemistry, Geophysics, Geosystems* (in revision).
12. Brugman, B.L., Lin, F., **Lv, M.**, Kenney-Benson, C., Popov, D., Miyagi, L., Dorfman, S. M. (2021). Strength, deformation, and equation of state of tungsten carbide to 66 GPa. *Acta Materialia* (in revision).
11. **Lv, M.**, Dorfman, S. M., Badro, J., Borensztajn, S., Greenberg, E., Prakapenka, V. B. (2021). Reversal of carbonate-silicate cation exchange in cold slabs in Earth's lower mantle. *Nature Communications*, 12(1), 1-7.
10. Wang, W., Liu, J., Yang, H., Dorfman, S. M., **Lv, M.**, Li, J., Zhu, F., Zhao, J., Hu, M. Y., Bi, W., Alp, E. E., Xiao, Y., Wu, Z., Lin, J. F. (2021). Iron force constants of bridgmanite at high pressure: implication to iron isotope fractionation in deep mantle. *Geochimica et Cosmochimica Acta*, 294, 215-231.
9. **Lv, M.**, Liu, J., Zhu, F., Li, J., Zhang, D., Xiao, Y., Dorfman, S. M. (2020). Spin transitions and compressibility of  $\epsilon$ -Fe<sub>7</sub>N<sub>3</sub> and  $\gamma$ -Fe<sub>4</sub>N: implications for iron alloys in terrestrial planet cores. *Journal of Geophysical Research: Solid Earth*, 124, e2020JB020660.
8. Tian, D., **Lv, M.**, Wei, S. S., Dorfman, S. M., Shearer, P. M. (2020). Global variations of Earth's 520- and 560-km discontinuities. *Earth and Planetary Science Letters*, 552, 116600.
7. **Lv, M.**, Liu, J., Greenberg, E., Prakapenka, V. B., Dorfman, S. M. (2020). Thermal equation of state of post-aragonite CaCO<sub>3</sub>-*Pmmn*. *American Mineralogist*, 105(9), 1365-1374.
6. Dorfman, S. M., Potapkin, V., **Lv, M.**, Greenberg, E., Kuppenko, I., Chumakov, A. I., Bi, W., Alp, E. E., Liu, J., Magrez, A., Dutton, S. E., Cava, R. J., McCammon, C. A., Gillet, P. (2020). Effects of composition and pressure on electronic states of iron in bridgmanite. *American Mineralogist*, 105(7), 1030-1039.
5. Liu, J., Dorfman, S. M., **Lv, M.**, Li, J., Zhu, F., Kono, Y. (2019). Loss of immiscible nitrogen from metallic melt explains Earth's missing nitrogen. *Geochemical Perspectives Letters*, 11, 18-22.
4. **Lv, M.**, Liu, X., Shieh, S. R., Xie, T., Wang, F., Prescher, C., Prakapenka, V.B. (2016) Equation of state of synthetic qandilite Mg<sub>2</sub>TiO<sub>4</sub> at ambient temperature. *Physics and Chemistry of Minerals*, 43(4): 301-306.
3. Wang, F. Liu, X., **Lv, M.**, Zhang, Y., Zhang, L., Zheng, H. (2016) A simple and effective device to decrease the temperature of the microscope objective in high temperature spectral experiments. *Spectroscopy and Spectral Analysis*, 36(9):2742-2748. (in Chinese with abstract in English)
2. **Lv, M.**, Liu, X., Xiong, Z., Wang, F. (2015) Influence of metal additives on the reaction rate of high-pressure and high-temperature experiments: add platinum powder into the coesite-corundum-kyanite system. *Chinese Journal of High Pressure Physics*, 29(2): 99-108. (in Chinese with abstract in English)
1. **Lv, M.**, Li, H., Zhao, M., Ma, Z., Yang, Z., Liang, J. (2014) Study on the order degree and geochemical characteristics of major elements of siliceous rock in eastern Qinling Area, China. *Spectroscopy and Spectral Analysis*, 34(11): 3005-3010.

## In Preparation:

4. **Lv, M.**, Dorfman, S. M. (2021). MinPhy: a Python package and GUI program for equation of state and phase diagram calculation and visualization in mineral physics.
3. **Lv, M.**, Dorfman, S. M., Liu, J., Farmer, A. B., Potapkin, V., Chumakov, A. I., McCammon, C. A., Greenberg, E., Prakapenka, V. B., Popov, D. Experimental insights into spin state and hyperfine parameters of  $\text{Fe}^{3+}$  in bridgmanite and silicate glass up to 91 GPa.
2. **Lv, M.**, Liu, X., He, Q., Zhang, Z. Crystal structures and component polyhedral compressibilities of  $\text{Al}_2\text{SiO}_5$  polymorphs.
1. **Lv, M.**, Liu, X., Xiong, Z., Chang, L., Kojitani, H. High-temperature Raman spectroscopic study and heat capacity calculation of  $\text{Al}_2\text{SiO}_5$  polymorphs.

#### Press Coverage:

2. Zhang, Y., Liu, Y., **Lv, M.** (2012) Key technologies on mine water inrush monitoring and warning system. Coal Geology and Exploration, 40(4): 60-62. (in Chinese with abstract in English)
1. **Lv, M.** (2012) Discussion on three types of diamond. Journal of the Graduates Sun Yat-Sen University (Natural Sciences & Medicine), 33(1): 34-43. (in Chinese with abstract in English)

#### Conference presentations (as presenting author only)

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13. **Lv, M.**, Liu, J., Zhu, F., Li, J., Zhang, D., Xiao, Y., Dorfman, S. M. (2020). Spin transitions and compressibility of  $\epsilon\text{-Fe}_7\text{N}_3$  and  $\gamma\text{'-Fe}_4\text{N}$ : implications for iron alloys in terrestrial planet cores. American Geophysical Union (AGU) Fall Meeting (Poster).
  12. **Lv, M.**, Dorfman, S. M., Badro, J., Borensztajn, S., Greenberg, E., Prakapenka, V. B. (2019). Experimental constraints on the fate of  $\text{MgCO}_3$  and  $\text{CaCO}_3$  subducted into Earth's lower mantle. COMPRES Annual Meeting (Talk).
  11. **Lv, M.**, Avery, M. S., Chen, X., Chidester, B. A., Deng, J., Farcy, B. J., Frost, D.A., Li, Z., Martin, J. F., Bruce, B. A., Dorfman, S. M., Liu, L. (2018) A multidisciplinary assessment of heat flux at the core mantle boundary. American Geophysical Union (AGU) Fall Meeting (Poster).
  10. **Lv, M.**, Dorfman, S. M., Badro, J., Borensztajn, S., Greenberg, E., Vitali B Prakapenka, V.B. (2018) Carbonate polymorphism reverses carbonate-silicate reaction in Earth's lower mantle. Cooperative Institute for Dynamic Earth Research (CIDER) 2018 Summer Program (Poster).
  9. **Lv, M.**, Dorfman, S. M., Liu, J., Farmer, A. B., Potapkin, V., Chumakov, A. I., McCammon, C. A., Prakapenka, V. B., Popov, D. (2017) Experimental insights into spin state and hyperfine parameters of  $\text{Fe}^{3+}$  in bridgmanite and silicate glass up to 91 GPa. AGU Fall Meeting (Talk).
  8. **Lv, M.**, Prescher, C., Prakapenka, V. B., Dorfman, S. M. (2017) Structure and Properties of Tetrahedral Amorphous Carbon. Deep Carbon Observatory (DCO) Workshop (Talk).
  7. **Lv, M.**, Liu, J., Prakapenka, V. B., Dorfman, S. M. (2017) Thermal equation of state of post-aragonite  $\text{CaCO}_3$  up to 75 GPa and 2500 K, COMPRES Annual Meeting (poster).
  6. **Lv, M.**, Liu, X. (2016) Component polyhedral compressibility of  $\text{Al}_2\text{SiO}_5$  polymorphs, Graduates Academic Forum, Peking University, Beijing, China (Talk).

5. **Lv, M.**, Liu, X. (2015) Large volume press and applications in high pressure research, Mineral Physics Seminar, University of Michigan, Ann Arbor, USA (Talk).
4. **Lv, M.**, Liu, X. (2015) Equation of state of synthetic qandilite  $\text{Mg}_2\text{TiO}_4$  at ambient temperature, 5th High Pressure Earth Science Symposium, Beijing, China (Talk).
3. **Lv, M.**, Liu, X. (2015) High-temperature Raman spectroscopic study and heat capacity calculation of  $\text{Al}_2\text{SiO}_5$  polymorphs, Annual Meeting of Chinese Geoscience Union, Beijing, China (Talk).
2. **Lv, M.**, Liu, X. (2015) High-temperature Raman spectroscopic study of  $\text{Al}_2\text{SiO}_5$  polymorphs, Graduates Academic Forum, Peking University, Beijing, China (Talk).
1. **Lv, M.**, Liu, X. (2014) Partial melting behavior of kyanite in the deep interior of the Earth, Geochemical Seminar, Institute of Geochemistry of Chinese Academy of Sciences, Guiyang, China (Talk).

### Workshops Attended

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<b>2020</b>	Asynchronous Program For Instructional Readiness, MSU
<b>2019</b>	Inelastic X-ray and Nuclear Resonant Scattering and Applications in Earth Sciences, COMPRES Annual Meeting
<b>2018</b>	CIDER pre-AGU workshop
<b>2018</b>	Nuclear Resonant Inelastic X-ray Scattering and Data Analysis, Argonne National Laboratory
<b>2018</b>	Relating geochemical and geophysical heterogeneity in the Earth, CIDER 2018 Summer Program
<b>2017</b>	CIDER pre-AGU workshop
<b>2017</b>	ENKI Datathon, Arizona State University
<b>2017</b>	The Origins of Volatiles in Habitable Planets, University of Michigan
<b>2017</b>	CONUSS and Synchrotron Mössbauer Data Analysis, Argonne National Laboratory
<b>2017</b>	Software Toolkit Development, COMPRES Annual Meeting
<b>2015</b>	2nd Deep Carbon Research Conference, Beijing, China
<b>2015</b>	Geochemical Frontiers Conference in Memory of Mr. Shen-Su Sun, Beijing, China
<b>2014</b>	Partition of Elements under High Pressure International Symposium, Beijing, China
<b>2014</b>	1st Non-Traditional Stable Isotope Summer School, Beijing, China
<b>2012</b>	IPACES Annual Conference, Guangzhou, Guangdong Province, China
<b>2012</b>	Geological Society of Taiwan Annual Conference, Taoyuan, Taiwan

### Research Skills

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- Expert in diamond anvil cell, multi anvil, piston cylinder apparatus, gas mixing furnace
- Experienced in Raman spectrometry, FT-IR spectrometry, powder and single crystal X-ray diffraction, FIB-SEM, EBSD, EPMA, TEM, LA-ICP-MS
- Experienced in synchrotron techniques, e.g. synchrotron Mössbauer spectroscopy, Paris-Edinburgh cell, laser-heating X-ray diffraction, Nuclear resonant inelastic X-ray scattering, X-ray emission
- High quality polishing techniques and machine shop skills in using welder, lathe, milling and drilling machine

- Proficient skills in GSAS/EXPGUI, Origin Pro, CorelDRAW, Dioptas, MDI Jade, PeakFit, Materials Studio, Mathematica, HeFESTo, Perple\_X, BurnMan, etc.
- Programming skills in Visual Basic, C/C++, Matlab, Python, Shell, LaTeX
- Geological field work experiences (2 months in total since Sept 2009)
- Full professional proficiency in English: able to use English fluently and accurately on all levels pertinent to professional needs. Able to read and write all styles and forms of English pertinent to professional needs

### Synchrotron Experience

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APS 3-ID-B	Synchrotron Mössbauer spectroscopy, Nuclear resonant inelastic X-ray scattering ()
APS 13-BM-C	X-ray diffraction
APS 13-ID-D	Laser-heating X-ray diffraction, XRD with multichannel collimator
APS 16-BM-B	Paris-Edinburgh press
APS 16-BM-D	X-ray diffraction
APS 16-ID-B	Laser-heating X-ray diffraction
APS 16-ID-D	NRIXS, X-ray emission, Synchrotron Mössbauer spectroscopy

### Proposals Awarded Funding or Facility Access as Principal Investigator

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<b>2019</b>	APS 13-ID-D (70235)	Continuing study of stability and thermal equation of state of iron-bearing post-perovskite (96 hours beamtime awarded)
<b>2018</b>	APS 13-ID-D (61837)	A systematic study on stability and thermal equation of state of iron-bearing post-perovskite (24 hours beamtime awarded)
<b>2018</b>	Alfred J. and Ruth Zeits Endowed Fellowship	The effects of Fe <sup>3+</sup> on bridgmanite and post-perovskite transition (\$8,000 awarded)
<b>2017</b>	APS 16-ID-D (56802)	Distinguishing the electronic environments of ferric and ferrous iron in silicate melts under lower mantle pressures (120 hours beamtime awarded)
<b>2017</b>	APS 13-ID-D (53301)	Structure and physical properties of amorphous tetrahedral carbon at high pressures (72 hours beamtime awarded)
<b>2017</b>	Neal Research Scholarship	Stability and thermal equation of state of CaCO <sub>3</sub> (\$1,800 awarded)
<b>2016</b>	APS 13-ID-D (51110)	Thermal equation of state and melting behavior of CaCO <sub>3</sub> at lower mantle conditions (96 hours beamtime awarded)

### Scientific Service

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<b>2017-</b>	Peer referee	Earth and Planetary Science Letters, Geophysical Research Letters, Minerals, Nature Communications
<b>2019</b>	Member	Meeting Planning Committee, COMPRES
<b>2018-2019</b>	Chair	Student and Postdoc Committee, COMPRES
<b>2017-2018</b>	Member	Student and Postdoc Committee, COMPRES
<b>Spring 2017</b>	Organizer	Bi-weekly Geophysics Journal Club, EES, MSU

**2013-2015**     Outstanding Lecturer     Li Siguang Science Team, Peking University