Qingyang Hu

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Professional Experience

Center for High Pressure Science and Technology Advanced Research, Beijing 2017 - current
Staff Scientist
- Independent PI managing a research group.
- Building a laboratory dedicated for high-pressure mineral chemistry by combining x-ray probes, Raman, laser heating and diamond anvil cell.

Department of Geological Sciences, Stanford University, Stanford, CA 2016 - 2017
Postdoctoral Researcher
- Proposed and confirmed the hypothesis of mantle oxygen reservoir based on experimental findings of oxygen-rich mineral phases like FeO_2 and Fe_4O_7.
- Established new theories about the separation of oxygen-hydrogen cycling at the lowermost mantle with publications in world's leading journals.

Geophysical Laboratory, Carnegie Institution of Washington, Washington, DC. 2014 - 2016
Postdoctoral Associate
- Found a new iron oxide FeO_2 that is relevant to the origin of theGreat Oxidation Event.
- Advanced experiment protocols to directly observe mineral chemistry between iron-oxides (e.g. FeO, Fe_2O_3) and water under the conditions of the lower mantle.

Department of Physics and Astronomy, George Mason University, Fairfax, VA 2009 - 2014
Research Assistant
- Found the metastable transition of silica by single-crystal crystallography.
- Modelled the free-energy surface of silica polymorphs using first-principles molecular dynamics.
- Developed python-based codes for visualizing crystals and analyzing x-ray data.
- Publish over 10 peer-reviewed articles in field's top journals.

Education

Ph.D. in Computational Materials Science
George Mason University, Fairfax VA, USA, December 2014

B.S. in Optical Science and Engineering,
Beijing Jiaotong University, Beijing, China, June 2009

Academic Achievement (on 16th, April, 2022)

Total Publications	60 (Web of Science), 62 (Google Scholar)
h-index	19 (Web of Science), 21 (Google Scholar)
Total citation	1463 (Web of Science), 1820 (Google Scholar)

Research Grant

2017-2022 CCCPC Foreign talent program for young scientist: Geophysics.
Amount: 3,000,000 CNY, PI.

2021-2023 CAEP Research Innovation grant. [CX20210048]
The physiochemical property and energy storing capability of Fe-O compounds under ultra-high-pressure conditions
Amount: 800,000 CNY, PI.

2021-2025 The Tencent XPLORER prize. [XPLORER-2020-1013]
Amount: 3,000,000 CNY, PI.

2022-2026 NSFC Program. [42150101]
Water cycle and transportation mechanism in Earth's deep lower mantle
Amount: 2,870,000 CNY, PI.

Appointments

2021- Youth editorial group member of *Matter and Radiation at Extremes*.

2021- Youth editorial group member of *National Science Review*.

2019- Member of European Geosciences Union, Germany.

2019- Member of Mineralogical Society of America, U.S.A.

2013- Member of American Physics Society, U.S.A.

2013- Member of American Geophysical Union, U.S.A

Award

2022 GRC Van Valkenburg Award

2021 MRE Youth Scientist Award, American Institute of Physics.

2020 The XPLORER prize, China.

2018 2018 Peer Review Awards (top 1% in Chemistry), Publons

2017 Top 10 Up-and-Coming Young Scientist, the Knowledge Magazine, China

2016 Outstanding Paper Award, Chinese High-Pressure Science Conference, China

2015 IUCr Young Scientist Award, International Union of Crystallography (Geophysics)

2015 Award for Outstanding CSI Dissertation, George Mason University, *Fairfax, VA*

2012 Carnegie Predoctoral Fellowship, Carnegie Institution of Washington, *Washington. DC*

Conference Talk

2021 Hu, Q., "The storage, chemistry and transportation of water in Earth´s deep lower mantle". ALBA-II workshop, Spain. 2021, *Invited*, *online*.

2021 Hu, Q., Hou, M., He, Y. and Yukai Zhuang. "Electrical Conductivity of Hydrous FeOOH and FeO_2H_x". Asian Conference on High Pressure Research. 2021, *Invited*, *online*.

2021 Hu, Q., Hou, M. and He, Y. "Solid to superionic transition in iron oxide-hydroxide". European Geosciences Union General Assembly 2021, *online*.

2020 Hu, Q., Liu, J. and Mao, H.-K. "Interaction between water and ferropericlase in Earth's lower mantle". AGU Fall Meeting, *online*.

2020 Hu, Q. Kim, D.Y., Lin, Y., Zhuang Y., Hou, M. and Mao, H.-K. "Reservoirs and behavior of hydrogen in Earth's lower mantle". EHPRG 2020, *Tenerife, Spain*.

2020 Hu, Q. and Mao, H.-K. "Mineral reservoirs and behaviors of hydrogen in Earth's lower mantle". European Geosciences Union General Assembly 2020, *Solicited talk*, *online*.

2020 Hu, Q. "Ionization of H in iron oxy-hydroxide". APS March Meeting, *Denver*, *CO. U.S.A.*

2018 Hu, Q., Zhu, S., Liu, J. and Zhu, Q. "A mechanism for oxygen concentration changes in Fe_2O_3 and FeO_2". AGU Fall Meeting, *San Francisco*, *CA. U.S.A.*

2018 Hu, Q., "Mineralogy and redox in Earth's lower mantle", Deep Volatile, Energy & Environments Summit, *Invited*, *Shanghai, China.*

2017 Hu, Q., Zhu, S., Mao, W.L., Mao, H.-K. and Sheng, H. "Dehydrogenation Mechanism and Phase Transition Kinetics in High-pressure FeO_2H", AGU Fall Meeting, *New Orleans*, *CA, U.S.A.*

2017 Hu, Q., Kim, D. Y., Liu, J., Yang, W., Meng, Y., Yang, L., Mao, W. L. and Mao, H.-K., "Formation of FeO_2 at high pressure and Earth's oxygen cycling", The 26th International Conference on High Pressure Science and Technology, *Invited*, *Beijing*, *China*.

2017 Hu, Q., Mao, H.-K., Mao, W.L., Discovery of pyrite-structured FeO_2 at high pressure, American Physics Society March Meeting, *New Orleans, LA, U.S.A.*

2016 Hu, Q., Kim, D. Y., Yang, W., Yang, L., Meng, Y., Zhang, L., Mao, H.-K., "Synthesis of FeO_2 and the Fe-O-H ternary system in lower mantle". American Geophysical Union Fall Meeting, *Invited*, *San Francisco*, *CA, U.S.A.*

2016 Hu, Q. and Mao, H.-K., "Phase transitions in the Fe-O-H ternary system at high pressure and high temperature", Frolic Goats Workshop on High Pressure Diffraction, *Invited*, *Poznań, Poland.*

2015 Hu, Q. "Polymorphic Phase Transition Mechanism in Compressed Coesite", Materials Research Society, *Boston, MA, U.S.A.*

Publication (2012/1-2022/4)

2022

62. Zhu, S., Gu, W., Zhang D., Xu, L., Liu Z.-P., Mao, H-k., and Hu, Q.*, Topological ordering of memory glass on extended length scales. ***J. Am. Chem. Soc.*** 144, 7414-7421 (2022).

61. Zhuang. Y., Gan, B., Cui, Z., Tang R., Tao R., Hou M., Gang, J., Catalin P., Gaston G., Zhang Y., and Hu, Q.*, Mid-mantle water transportation implied by the electrical and seismic properties of ε-FeOOH. ***Sci. Bull.*** 67, 748-754 (2022).

60. Huang S. and Hu, Q.* Medium-range structure motifs of complex iron oxides. ***J. Appl. Phys.,*** 131, 070902 (2022).

59. Zhuang, Y., Li, J., Lu, W., Yang, X., Du, Z.* and Hu, Q.* High temperature melting curve of basaltic glass by laser flash heating. ***Chin. Phys. Lett.,*** 39, 020701 (2022).

58. Wu, S., Liu, C., Li, X., Xiao, B.* and Hu, Q.* Freeze-thaw controlled aggregation mechanism of humic acid-coated goethite: Implications for organic carbon preservation. ***Geoderma,*** 406, 115514 (2022).

57. Ishii, T.*, Miyajima, N., Criniti, G., Hu, Q., Glazyrin, K. and Katsura T. High pressure-temperature phase relations of basaltic crust up to mid-mantle conditions. ***Earth. Planet. Sci. Lett.*** 584, 117472 (2022).

56. Zhu, S.-c.*, Huang, Z.-b., Hu, Q. and Xu, L. Pressure tuned incommensurability and guest structure transition in compressed scandium from machine learning atomic simulation. ***Phys. Chem. Chem. Phys.*** 24**,** 7007-7013 (2022).

2021

55. Hu, Q., Li, B.,* Gao, X., Lei, S., Yan B., and Mao, H.-K. Ultrasound elasticity of diamond at gigapascal pressures. ***Proc. Nat. Acad. Sci. U.S.A.,*** 118, e2118490118 (2021).

54. Hu, Q.* and Mao, H.-K. Role of hydrogen and proton transportation in Earth's deep mantle. ***Matter Radiat. Extreme.,*** 6, 068101 (2021).

53. Hu, Q.* and Mao, H.-K. Born's valence force-field model for diamond at terapascals: Validity and implications for the primary pressure scale. ***Matter Radiat. Extreme.,*** 6, 068403 (2021).

52. Hu, Q., Liu, J.*, Chen J., Yan B., Meng Y., Prakapenka, V.B., Mao, W.L. and H.-K. Mao*, Mineralogy of the deep lower mantle in the presence of H_2O. ***Natl. Sci. Rev.***, 8, nwaa098 (2021).

51. Hu, Q.*, Liu, J. Deep mantle hydrogen in the pyrite-type FeO_2-FeO_2H system**.** ***Geoscience. Front.*** 12, 975-981 (2021).

50. Hou. M., He, Y., *et al*., Liu, J*., Kim, D.K.*, Hu, Q.*, *et al*., Superionic iron oxide–hydroxide in Earth's deep mantle. ***Nat. Geosci.*** 14, 174-178 (2021).

49. Cui, Z., Bu, K., Zhuang, Y., Donnelly M.-E., Zhang, D., Dalladay-Simpson P., Howie, R., Zhang, J., Lü, X., and Hu, Q.* Phase transition mechanism and bandgap engineering of Sb_2S_3 at gigapascal pressures. ***Commun. Chem.,*** **4**, 125 (2021).

48. Liu, J.*, Wang, C., Lü, C., Su, X., Liu, Y., Tang, R., Chen, J., Hu, Q.,* Mao, H.-K. and Mao W.L., Evidence for oxygenation of Fe-Mg oxides at mid-mantle conditions and the rise of deep oxygen.

Natl. Sci. Rev., 8, nwaa096 (2021).

47. Mao, H.-K.*,* Ding Y., Hu, Q., Lin, Y., Liu, J. and Zhang, L., The deep Earth engine driving major surface events**.** ***Acta Geol. Sin. Engl..*** 95, 68-69 (2021).

46. Zhu, S.-c.* and Hu, Q., Unraveling the structural transition mechanism of room-temperature compressed graphite carbon. ***Phys. Chem. Chem. Phys.*** 23, 20560-20566 (2021).

45. Tang, R.*, Jin L., Kim, D.Y., Mao, H-K.*, Hu, Q., *et al.,* Chemistry and *P-V-T* equation of state of FeO_2H_x at the base of Earth's lower mantle and their geophysical implications. ***Sci. Bull.*** 66, 1954-1958 (2021).

44. Deng, H.*, Zhang, J., Jeong, M.Y., Wang, D., Hu, Q., *et al*. Han, M.J.*, Chang, J.*, Weng, H., Yang, D.*, *et al*., Metallization of quantum material $GaTa_4Se_8$ at high pressure. ***J. Phys. Chem. Lett.*** 12, 5601-5607 (2021).

43. Guo, S., Bu, K., Li, J; Hu, Q., Luo, H., He, Y., Wu, Y., Zhang, D., Zhao, Y., Yang, W., Kanatzidis, M.G. and Lü. X.*, Enhanced photocurrent of all-inorganic two-dimensional perovskite $Cs_2PbI_2Cl_2$ via pressure-regulated excitonic features. ***J. Am. Chem. Soc.*** 143, 2545-2551 (2021).

42. Zhuang, Y., Su, X., Salke, N.P., Cui, Z., Hu, Q., Zhang, D. and Liu, J. The effect of nitrogen on the compressibility and conductivity of iron at high pressure. ***Geoscience. Front.*** 12, 983-989 (2021).

41. Lü, X., Stoumpos, C., Hu, Q., *et al*. Regulating off-centering distortion maximizes photoluminescence in halide perovskites. ***Natl. Sci. Rev.*** 8, nwaa288 (2021).

2020

40. Lin, Y.*, Hu, Q.*, Zhu, L. and Meng, Y. Structure and stability of iron fluoride at high pressure–temperature and implication for a new reservoir of fluorine in the deep Earth. ***Minerals*** 10, 783 (2020).

39. Zhuang, Y., Wu, L., Gao, B., Cui, Z., Gou, H., Zhang, D., Zhu, S.* and Hu, Q.* Deviatoric stress induced quasi-reconstructive phase transition in ZnTe. ***J. Mater. Chem. C.*** 8, 3795-3799 (2020).

38. Lin, Y., Hu, Q.*, Meng, Y., Walter, M. and Mao, H.-K., Evidence for the stability of ultrahydrous stishovite in Earth's lower mantle. ***Proc. Nat. Acad. Sci. U.S.A.*** 117, 184-189 (2020).

37. Kong, L., Gong, J., Hu, Q., Capitani, F., Celeste, A., Hattori, T., Sano-Furukawa, A., Li, N., Yang W., Liu, G. and Mao H.-K. Suppressed lattice disorder for large emission enhancement and structural robustness in hybrid lead iodide perovskite discovered by high-pressure isotope effect. ***Adv. Funct. Mater***. 2009131 (2020).

36. Wang, Y., Guo, S., Luo, H., Zhou, C., Lin, H., Ma, X., Hu, Q., Du, M.-H., Ma, B., Yang, W. and Lü, X. Reaching 90% photoluminescence quantum yield in one-dimensional metal halide $C_4N_2H_{14}PbBr_4$ by pressure-suppressed nonradiative loss. ***J. Am. Chem. Soc.*** 142, 16001-16006. (2020).

35. Kong, L., Liu, G., Gong, J., Mao, L., Chen, M., Hu, Q., Lü, X., Yang, W., Kanatzidis, M.G. and Mao, H.-K. Highly tunable properties in pressure-treated two-dimensional Dion-Jacobson perovskites. ***Proc. Nat. Acad. Sci. U.S.A.*** 117, 16121-16126 (2020).

34. Qin, Q., Wan, B., Yan B., Gao, B., Hu, Q., Zhang, D., Hosono, H. and Gou, H. Potential Interaction of Noble Gas Atoms and Anionic Electrons in Ca_2N. ***J. Phys. Chem. C.*** 124, 12213-12219 (2020).

33. Liu, G., Kong, L., Hu, Q. and Zhang, S. Diffused morphotropic phase boundary in relaxor-$PbTiO_3$

crystals: High piezoelectricity with improved thermal stability. ***Appl. Phys. Rev***. 7, 021405, (2020).

2019

32. Liu, J., Hu, Q.*, Bi, W., Yang, L., Xiao, Y., Chow, P., Meng, Y., Prakapenka, V. B., Mao, H.-K.* and Mao, W. L*. Altered chemistry of oxygen and iron under deep Earth conditions. ***Nat. Commun.*** 10, 153 (2019).
31. Zhuang, Y., Cui, Z., Zhang, D., Liu, J., Tao, R. and Hu, Q.*, Experimental Evidence for Partially Dehydrogenated ε-FeOOH. ***Crystals***, 9, 356 (2019).
30. Zhu, S., Liu, J., Hu, Q.*, Mao, W. L., Meng, Y., Zhang, D., Mao, H.-K. and Zhu, Q.* Structure-controlled oxygen concentration in Fe_2O_3 and FeO_2. ***Inorg. Chem.*** 58, 5476-5482 (2019).
29. Jang, B.G., Liu, J., Hu, Q., Haule, K., Mao, H.-K., Mao, W.L., Kim, D.Y. and Shim, J.H. Electronic spin transition in FeO_2: Evidence for Fe(II) with peroxide FeO^{2-}. ***Phys. Rev. B*** 100, 014418 (2019).
28. Mao, H.-K., Ding, Y., Kim, D.Y., Hu, Q., Liu, J., Yang, L., Yang, W., Zhang, L. and Mao, W.L. Global scale uniformitarianism and catastrophism dictated by crust-to-core volatile cycles. ***Acta. Geol. Sin.-Engl.***, 93, 8-8 (2019).
27. Zhang, G., Zhang, Q., Hu, Q., Wang B. and Yang W., Giant enhancements in electronic transport and photoelectric properties of bismuth oxysulfide by pressure-driven 2D-3D structural reconstruction. ***J. Mater. Chem. A***, 7, 4019-4025 (2019).

2018

26. Tang, H., Wan, B., Gao, B., Muraba, Y., Qin, Q., Yan, B., Chen, P., Hu, Q., *et al*. Metal-to-semiconductor transition and electronic dimensionality reduction of Ca_2N electride under pressure. ***Adv. Sci.*** 5, 1800666 (2018).
25. Liu, G., Gong, J., Kong, L., Schaller R. D., Hu, Q., *et al*. Isothermal pressure-derived metastable states in 2D hybrid perovskites showing enduring bandgap narrowing. ***Proc. Nat. Acad. Sci. U.S.A.*** 115, 8076-8081 (2018).
24. Tang, H., Yuan, X., Yu, P., Hu, Q., *et al.* Revealing the formation mechanism of ultrahard nano twinned diamond from onion carbon. ***Carbon***, 129, 159-167 (2018).

2017

23. Hu, Q., Kim, D. Y., Liu, J., Meng, Y., Yang, L., Zhang, D., Mao, W. and Mao H.-K. Dehydrogenation of goethite in Earth's deep lower mantle. ***Proc. Nat. Acad. Sci. U.S.A.*** 114, 1498-1501 (2017).
22. Hu, Q., Shu, J.-F., Yang, W., Park, C., Chen. M. W., Fujita, T., Mao, H.-K. and Sheng, H. W. Stability limits and transformation pathways of quartz under high pressure. ***Phys. Rev. B***, 95, 104112 (2017).
21. Zhu, S., Hu, Q.*, Mao, W. L., Mao, H.-K., and Sheng, H. Hydrogen-bond symmetrization breakdown and dehydrogenation in compressed FeO_2H. ***J. Am. Chem. Soc.*** 139, 12129-12132 (2017).
20. Liu, J., Hu, Q., Kim, D. Y., Wu, Z., Wang, W., Xiao, Y., Paul, C., Meng, Y., Prakapenka, V. B., Mao, H.-K. and Mao, W. L., Hydrogen-bearing iron peroxide and the origin of ultralow-velocity zones.

Nature 551, 494-497 (2017).

19. Mao, H.-K., Hu, Q., Yang, L., Liu, J., Kim, D. Y., Meng, Y., Zhang, L., Prakapenka, V. B., Yang, W. and Mao, W. L. When water meets iron at Earth's core-mantle boundary. ***Natl. Sci., Rev.*** 4, 870-878 (2017).

18. Liu, G., Kong, L., Guo, P., Stoumpos, C. C., Hu, Q., *et al.,* Two-regimes of bandgap redshift and partial ambient retention in pressure treated two-dimensional perovskites. ***ACS Energy Lett.*** 2，2518-2524 (2017).

17. Yu, Z., Wu, W., Lu, P., Zhao, J., Cheng, J., Hu, Q., Yuan, Ye., Li, X., Pei, C., Chen, F., Yan, Z., Yan, S., Yang, K., Sun, J., Luo, J. and Wang, L. Structural evolution behavior of manganese monophosphide under high pressure: experimental and theoretical study, ***J. Phys. Condens. Matter.*** *29, 254002* (2017).

16. Zhao, J., Yu, Z., Hu, Q., *et al.,* Structural phase transitions of $(Bi_{1-x}Sb_x)_2(Te_{1-y}Se_y)_3$ compounds under high pressure and the influence of the atomic radius on the compression processes of tetradymites. ***Phys. Chem. Chem. Phys.*** 19, 2207-2216 (2017).

15. Liu, G., Kong, L., Gong, J., Yang. W., Mao, H.-K., Hu, Q., *et al.* Pressure-induced bandgap optimization in lead-based perovskites with prolonged carrier lifetime and ambient retainability. ***Adv. Funct. Mater.*** 27, 1604208 (2017).

2016

14. Hu, Q., Kim, D.Y., Yang, W., Yang, L., Meng, Y., Zhang, L. and Mao, H.-K. FeO_2 and FeOOH under deep lower-mantle conditions and Earth's oxygen–hydrogen cycles. ***Nature***, 531, 241-244 (2016).

13. Zhang, Y., Wu, L., Wan, B., Lin, Y., Hu, Q., Zhao, Y., Gao, R., Li, Z., Zhang, J., Gou, H., Diverse ruthenium nitrides stabilized under pressure: a theoretical prediction. ***Sci. Rep.*** 6, 33506 (2016).

12. Li, C., Zhao, J., Hu, Q., Lixiu, Z., Yu, Z., and Yan, H., Crystal structure and transporting properties of Bi_2S_3 under high pressure: Experimental and theoretical studies. ***J. Alloys Compd.*** 688, 329-335 (2016).

11. Lü, X., Wang, Y., Stoumpos, C. C., Hu, Q., *et al.*, Enhanced structural stability and photo responsiveness of $CH_3NH_3SnI_3$ perovskite via pressure-induced amorphization and recrystallization. ***Adv. Mater.*** 28, 8663-8668. (2016).

10. Kong, L., Liu, G., Gong, J., Hu, Q., *et al.*, Simultaneous band-gap narrowing and carrier-lifetime prolongation of organic-inorganic trihalide perovskites. ***Proc. Nat. Acad. Sci. U*.S.A.** 113**,** 8910-8915 (2016).

9. Li, C., Ke, F., Hu, Q., Yu, Z.H., Zhao, J., Chen, Z. and Yan, H. Correlated structural and electroni phase transformation in transition metal chalcogenide under high pressure. ***J. Appl. Phys.***, 119, 135901 (2016).

2012-2015

8. Hu, Q., Shu, J-F., Cadien, A., Meng, Y., Yang, W., Sheng, H., and Mao, H.-K. Polymorphic phase transition mechanism of compressed coesite, ***Nat. Commun.*** 6, 6630 (2015).

7. Yu, Z., Wu, W., Hu, Q., Zhao, J., Li, C., Yang. K., Cheng. J., Luo, J., Wang, L. and Mao, H.-K. Anomalous anisotropic compression behavior of superconducting CrAs under high pressure. ***Proc.***

Nat. Acad. Sci. U.S.A. 112, 14766 (2015).

6. Wang, Y., Wu. L., Lin. Y., Hu, Q., Li. Z., Liu H., Zhang. Y., Gou. H., Yao. Y., Zhang. J., Gao. F. and Mao, H.-K. Structures and stability of novel transition metal (M=Co, Rh, Co and Ir) borides. ***Phys. Rev. B*** 92, 174106 (2015).
5. Yu, Z., Lin, W., Hu, Q., Zhao, J., Yan. S., Yang. K., Suchomel, M., Sinogeikin, S., Gu, G. and Mao, H.-K. Structural phase transition in Bi_2Se_3 under high pressure, ***Sci. Rep.*** 5, 15939 (2015).
4. Cadien, A., Hu, Q., Meng, Y., Cheng, Y., Chen, M., Shu, J., Mao, H.-K. and Sheng, H. First-order liquid-liquid phase transition in cerium, ***Phys. Rev. Lett.*** 10, 125503 (2013).
3. Lü, X., Hu, Q., Yang, W., Bai, L. Sheng, H., Wang, L., Huang, F., Wen, J., Miller, D. J. and Zhao, Y. Pressure-induced amorphization in single-crystal Ta_2O_5 nanowires, ***J. Am. Chem. Soc.*** 135, 13947-13953 (2013).
2. Zeng, Q., Mao, W. L., Sheng, H., Zeng, Z., Hu, Q., Meng, Y., Lou, H., Peng, F., Yang, W., Sinogeikin, S. V. and Jiang, J.-Z. The effect of composition on pressure-induced devitrification in metallic glasses. ***Appl. Phys. Lett.*** 102 171905 (2013).
1. Ding, Y., Cai, Z., Hu, Q., Sheng, H., Chang, J., Hemley, R. and Mao W. L. Nanoscale diffraction imaging of the high-pressure transition in $Fe_{1-x}O$, ***Appl. Phys. Lett.*** 100**,** 041903 (2012).