

Kyusei Tsuno

Yale University, 210 Whitney Ave, New Haven, CT 06511, USA

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EDUCATION

2004-2007 **Ph.D in Science/Earth Science**

Tohoku University, Sendai, Japan

Fe-O-S melting phase relations at high pressures and the role of sulfur and oxygen in structure of planetary cores (Adviser: Prof. Eiji Ohtani)

2002-2004 **M.Sc in Earth Science**

Tohoku University, Sendai, Japan

1998-2002 **B.Sc in Science/Earth Science**

Tohoku University, Sendai, Japan

PROFESSIONAL APPOINTMENTS

2026- Research Scientist/Lab Manager, Yale University, CT

2022-2025 Research Scientist, Eyring Materials Center and FORCE, Arizona State University, Tempe, AZ

2009-2022 Research Scientist/Lab Manager, Rice University, Houston, TX (Permanent since 2014)

2009-2015 Visiting Scientist, Lunar and Planetary Institute, Houston, TX

2007-2009 Postdoctoral Researcher, Bayerisches Geoinstitut (BGI), Bayreuth, Germany
(Mentor: Prof. David C. Rubie and Prof. Daniel. J. Frost)

FELLOWSHIPS, AND AWARDS

2008-2009 Visiting Scientist Fellowship of BGI, University of Bayreuth, Germany

2006 Outstanding Graduate Student Award, 21st COE (Center of Excellence) Program (\$1,000)

PRACTICAL AND ANALYTICAL PROFICIENCY

- Experience in the installation, calibration, and maintenance of, multi-anvil (Kawai-, Osugi-, and Walker-type) presses, piston-cylinder devices, and 1-atm gas mixing furnaces.
- Analysis using Electron Probe Micro Analyzer (EPMA), Fourier Transform Infrared Spectroscopy (FTIR), Raman Spectroscopy, and Secondary Ion Mass Spectrometry (in collaboration with others)
- Programming using MATLAB

SELECTED POPULAR MEDIA COVERAGE

- Our *Geophysical Research Letters* (2013) paper [16 in **publication list**] was highlighted by *Nature* (495, 177-178. doi:[10.1038/495177a](https://doi.org/10.1038/495177a)), *Nature Geoscience* (6, 18. doi:[10.1038/ngeo1700](https://doi.org/10.1038/ngeo1700)), and *AGU* (EOS, Transactions, American Geophysical Union 94, 148. doi:[10.1002/2013EO150015](https://doi.org/10.1002/2013EO150015)).

REVIEWING WORK

Science [1], Nature Geoscience [1], Earth and Planetary Science Letters [1], Geochimica et Cosmochimica Acta [7], Journal of Geophysical Research – Solid Earth [2], American Mineralogist [6], Physics of the Earth and Planetary Interiors [1], Contributions to Mineralogy and Petrology [2], Geological Magazine [1], International Geology Review [1], Journal of Mineralogical and Petrological Sciences [1], GSA Bulletin [1], Matter and Radiation at Extremes [1], NSF proposal [1]

MEMBERSHIP WITH PROFESSIONAL SOCIETIES

2006-Present: Member, American Geophysical Union

2005-Present: Member, Japan Society of High Pressure and Technology

PUBLICATION LIST

(*Peer Reviewed*)

(#designates supervised students for High-*P* experiments and analysis of recovered products)

1. **Tsuno, K.**, Grewal, D.S., Xu, V. #, Leinbach, L., Leinenweber, K., Wittmann, A. & Shim, S.H. (2024) The effect of nitrogen on the dihedral angle between Fe–Ni Melt and ringwoodite: Implications for the nitrogen deficit in the Bulk Silicate Earth. *Geophysical Research Letters* **51**, e2024GL109584. doi:[10.1029/2024GL109584](https://doi.org/10.1029/2024GL109584) [*Citation numbers (by Google Scholar): 2*]
2. Johnson, A. #, Dasgupta, R., Costin, G. & **Tsuno, K.** (2024) Electron probe microanalysis of trace sulfur in experimental basaltic glasses and silicate minerals. *American Mineralogist* **109**: 2162-2172. doi:[10.2138/am-2023-9157](https://doi.org/10.2138/am-2023-9157) [*4*]

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3. Ding, S. [#], Dasgupta, R. & **Tsuno, K.** (2020) The solidus and melt productivity of nominally anhydrous Martian mantle constrained by new high pressure-temperature experiments – implications for crustal production and mantle source evolution. *Journal of Geophysical Research - Planets* doi: [10.1029/2019JE006078](https://doi.org/10.1029/2019JE006078) [**13**]
4. Grewal, D.S. [#], Dasgupta, R., Holmes, A.K., Costin, G, Li Y. & **Tsuno K.** (2019) The fate of nitrogen during core-mantle separation on Earth. *Geochimica et Cosmochimica Acta* **251**: 87-115. doi: [10.1016/j.gca.2019.02.009](https://doi.org/10.1016/j.gca.2019.02.009) [**58**]
5. Grewal, D.S. [#], Dasgupta, R., Sun, C., **Tsuno K.** & Costin, G. (2019) Delivery of Carbon, Nitrogen and Sulfur to the Silicate Earth. *Science Advances* **5**: eaau3669. doi:[10.1126/sciadv.aau3669](https://doi.org/10.1126/sciadv.aau3669) [**106**]
6. **Tsuno, K.**, Grewal, D.S. [#] & Dasgupta, R. (2018). Core-mantle fractionation of carbon in Earth and Mars: The effects of sulfur. *Geochimica et Cosmochimica Acta* **238**: 477-495. doi: [10.1016/j.gca.2018.07.010](https://doi.org/10.1016/j.gca.2018.07.010) [**54**]
7. Saha, S. [#], Dasgupta, R. & **Tsuno K.** (2018) High pressure-temperature phase relations of a depleted peridotite fluxed by CO₂-H₂O-bearing siliceous melts and the origin of mid-lithospheric discontinuity. *Geochemistry, Geophysics, Geosystems* **19**(3): 595-620. doi: [10.1002/2017GC007233](https://doi.org/10.1002/2017GC007233) [**45**]
8. Li, Y. [#], Dasgupta, R. & **Tsuno K.** (2017) Carbon contents in reduced basalts at graphite saturation: Implications for the degassing of Mars, Mercury, and the Moon. *Journal of Geophysical Research – Planets* **122**. doi:[10.1002/2017JE005289](https://doi.org/10.1002/2017JE005289) [**47**]
9. Duncan, M.S. [#], Dasgupta, R. & **Tsuno K.** (2017) Experimental determination of CO₂ content at graphite saturation along a natural basalt-peridotite melt join: Implications for the fate of carbon in terrestrial magma oceans. *Earth and Planetary Science Letters* **466**: 115-128. doi:[10.1016/j.epsl.2017.03.008](https://doi.org/10.1016/j.epsl.2017.03.008) [**38**]
10. Mallik, A. [#], Dasgupta, R., **Tsuno, K.** & Nelson, J. (2016) Effects of water, depth and temperature on partial melting of mantle-wedge fluxed by hydrous sediment-melt in subduction zones. *Geochimica et Cosmochimica Acta* **195**: 226-243. doi:[10.1016/j.gca.2016.08.018](https://doi.org/10.1016/j.gca.2016.08.018) [**74**]
11. Li, Y. [#], Dasgupta, R. & **Tsuno K.** (2016) Carbon and sulfur budget of the silicate Earth explained by accretion of differentiated embryos. *Nature Geosciences* **9**: 781-785. doi:[10.1038/ngeo2801](https://doi.org/10.1038/ngeo2801) [**96**]
12. Li, Y. [#], Dasgupta, R. & **Tsuno K.** (2015) The effects of sulfur, silicon, water, and oxygen fugacity on carbon solubility and partitioning in Fe-rich alloy melt-silicate melt systems at 3 GPa and 1600 °C: Implications for core-mantle differentiation and degassing of magma oceans and reduced planetary mantles. *Earth and Planetary Science Letters* **415**: 54-66. doi:[10.1016/j.epsl.2014.12.018](https://doi.org/10.1016/j.epsl.2014.12.018) [**92**]
13. **Tsuno, K.** & Dasgupta, R. (2015) Fe–Ni–Cu–C–S phase relations at high pressures and temperatures – The role of sulfur in carbon storage and diamond stability at mid- to deep-upper mantle. *Earth and Planetary Science Letters* **412**: 54-66. doi:[10.1016/j.epsl.2014.12.018](https://doi.org/10.1016/j.epsl.2014.12.018) [**71**]
14. Ding, S. [#], Dasgupta, R. & **Tsuno, K.** (2014) Effects of water, depth and temperature on partial melting of mantle-wedge fluxed by hydrous sediment-melt in subduction zones. *Geochimica et Cosmochimica Acta* **131**: 227-246. doi:[10.1016/j.gca.2014.02.003](https://doi.org/10.1016/j.gca.2014.02.003) [**78**]
15. Dasgupta, R., Mallik, A., **Tsuno K.**, Withers, A.C., Hirth, G. & Hirschmann, M.M. (2013) Carbon-dioxide-rich silicate melt in the Earth's upper mantle. *Nature* **493**: 211-215. doi:[10.1038/nature11731](https://doi.org/10.1038/nature11731) [**386**]
16. **Tsuno, K.**, Frost, D.J. & Rubie, D.C. (2013) Simultaneous partitioning of silicon and oxygen into the Earth's core during early Earth differentiation. *Geophysical Research Letters* **40**: doi:[10.1029/2012GL054116](https://doi.org/10.1029/2012GL054116) [**71**]
17. **Tsuno K.**, Dasgupta, R., Danielson, L. & Richter, K. (2012) Flux of carbonate melt from deeply subducted pelitic sediments – geophysical and geochemical implications for the source of Central American volcanic arc. *Geophysical Research Letters* **39**: L16307. doi:[10.1029/2012GL052606](https://doi.org/10.1029/2012GL052606) [**86**]
18. **Tsuno, K.** & Dasgupta, R. (2012) The effect of carbonates on near-solidus melting of pelite at 3 GPa: Relative efficiency of H₂O and CO₂ subduction. *Earth and Planetary Science Letters* **319**: 185-196. doi:[10.1016/j.epsl.2011.12.007](https://doi.org/10.1016/j.epsl.2011.12.007) [**91**]
19. **Tsuno, K.** & Dasgupta, R. (2011) Melting phase relation of nominally anhydrous, carbonated pelitic-eclogite at 2.5–3.0 GPa and deep cycling of sedimentary carbon. *Contributions to Mineralogy and Petrology* **162**: 743-763. doi:[10.1007/s00410-010-0560-9](https://doi.org/10.1007/s00410-010-0560-9) [**153**]
20. **Tsuno, K.**, Frost, D.J. & Rubie, D.C. (2011) The effects of nickel and sulphur on the core–mantle partitioning of oxygen in Earth and Mars. *Physics of the Earth and Planetary Interior* **185**: 1-12. doi [10.1016/j.pepi.2010.11.009](https://doi.org/10.1016/j.pepi.2010.11.009) [**14**]
21. Rubie, D.C., Frost, D.J., Mann, U., Asahara, Y., Nimmo, F., **Tsuno, K.**, Kegler, P., Holzheid, A. & Palme, H. (2011) Heterogeneous accretion, composition and core–mantle differentiation of the Earth. *Earth and Planetary Science Letters* **301**: 31-42. doi:[10.1016/j.epsl.2010.11.030](https://doi.org/10.1016/j.epsl.2010.11.030) [**442**]
22. **Tsuno, K.** & Ohtani, E. (2009) Eutectic temperatures and melting relations in the Fe–O–S system at high pressures and temperatures. *Physics and Chemistry of Minerals*, **36**, 9-17. doi:[10.1007/s00269-008-0254-2](https://doi.org/10.1007/s00269-008-0254-2) [**17**]

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23. **Tsuno, K.**, Terasaki, H., Ohtani, E., Suzuki, A., Asahara, Y., Nishida, K., Sakamaki, T., Funakoshi, K. & Kikegawa, T. (2007) In situ observation and determination in the Fe-O-S melt at 3 GPa using a synchrotron X-ray radiographic technique. *Geophysical Research Letters*, 34, L17303, doi:[10.1029/2007GL030750](https://doi.org/10.1029/2007GL030750) [15]
24. **Tsuno, K.**, Ohtani, E. & Terasaki, T. (2007) Immiscible two-liquid regions in the Fe–O–S system at high pressure: Implications for planetary cores. *Physics of the Earth and Planetary Interiors*, 160, 75-85. doi:[10/1016/j.pepi.2006.09.004](https://doi.org/10.1016/j.pepi.2006.09.004) [52]

(non-Refereed)

25. **Tsuno, K.**, Terasaki, H. & Ohtani, E. (2007) In-situ observation of liquid immiscibility in the Fe-O-S system at high pressures and temperatures, *SPRING-8 Research Frontiers* 126-127 [INVITED] (http://www.spring8.or.jp/pdf/en/res_fro/07/126-127.pdf).

SEMINARS AND COLLOQUIA

- **Tsuno, K.** Cycling of light and volatile elements (O, Si, C, H, and S) in Earth's deep interior and future perspectives for high-P research. *Arizona State University* (March 2022)
- **Tsuno, K.** The effect of sulfur on carbon solubility and partitioning in the alloy-silicate systems: Implications for core-mantle fractionation of carbon and sulfur during accretion of Earth. *Geodynamics Research Center, Ehime University* (October 2017)
- **Tsuno, K.** Establishing the carbon and sulfur budget of the bulk silicate Earth during the multi-stage core formation processes. *Kyoto University* (March 2016)
- **Tsuno, K.** Origin of carbon and sulfur in the rocky bodies of the inner solar system. *Osaka University* (March 2016)
- **Tsuno, K.** Immiscibility of Fe-O-S melts at high pressures and implications for the structure of terrestrial planets. *Bayerisches Geoinstitut, University of Bayreuth* (October 2006)

CONFERENCE CHAIR

- **Tsuno, K.**, Gréaux, S., Chariton, S. & Zhang, D. (2022) MR45 - Advanced Experimental, Computational and Analytical Approaches in Exploring Deep Planetary Interiors. *AGU Fall Meeting* (December 2022)

PRESENTATIONS AT SCIENTIFIC MEETINGS AND CONFERENCES

- **Tsuno, K.**, Grewal, D.S., Xu, V., Leinbach, L., Leinenweber, K., Wittmann, A. & Shim, S.H. (2024) Wetting property of Fe-Ni-N alloy melt in ringwoodite: Implications for nitrogen depletion in the bulk silicate Earth. *Goldschmidt Conference*, Chicago (August 2024) [ORAL]
- **Tsuno, K.**, Grewal, D.S., Xu, V., Leinbach, L., Leinenweber, K., Wittmann, A. & Shim, S.H. (2024) Wetting property of Fe-Ni-N alloy melt in ringwoodite and its application to nitrogen depletion in the bulk silicate Earth. *Japan Geoscience Union Conference*, Makuhari, Japan (May 2024) [ORAL]
- **Tsuno, K.**, Grewal, D.S., Xu, V., Leinbach, L., Leinenweber, K., Wittmann, A. & Shim, S.H. (2023) Wetting Property of Fe-Ni-N Alloy Liquid in Ringwoodite – Implications for Nitrogen Depletion in the Bulk Silicate Earth. *AGU Fall Meeting* (December 2023) [POSTER]
- **Tsuno, K.**, Leinenweber, K., Navrotsky, A., Sharp, T.G., Shim, S.H. & Smith, D.J. (2022) New High-Pressure Experimental facility in FORCE (Facility for Open Research in a Compressed Environment) and scientific applications. *AGU Fall Meeting* (December 2022) [POSTER]
- **Tsuno, K.**, Dasgupta, R. & Grewal, D.S. The effects of sulfur on carbon partitioning and solubility in high pressure-temperature alloy-silicate systems: Implications for fractionation of carbon and sulfur during accretion and core formation of Earth and Mars. *AGU Fall Meeting* (December 2017) [ORAL]
- **Tsuno, K.**, Dasgupta, R. & Grewal, D.S. The effects of sulfur on carbon partitioning and solubility in high pressure-temperature alloy-silicate systems. *Deep Carbon Observatory Extreme Physics and Chemistry Workshop*, Arizona State University (November 2017) [POSTER]
- **Tsuno, K.**, Dasgupta, R. & Grewal, D.S. The effects of sulfur on carbon partitioning and solubility in high pressure-temperature alloy-silicate systems. *Gordon Research Conference* (June 2017). [POSTER]
- **Tsuno, K.** & Dasgupta, R. Carbon Storage in the Mid- to Deep- Upper Mantle Constrained by Phase Relations in the Fe-Ni-Cu-C-S system. *AGU Fall Meeting* (December 2014) [ORAL]
- **Tsuno, K.**, Dasgupta, R., Danielson, L. & Richter, K. Composition of silicate partial melts of carbonated pelite at 3-5 GPa and genesis of arc magma. *AGU Fall Meeting* (December 2012) [POSTER]
- **Tsuno, K.**, Dasgupta, R., Danielson, L. & Richter, K. Subduction cycling of C-O-H volatiles from sediment melting. *Goldschmidt Conference*, Prague, Czech (August 2011) [ORAL]

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- **Tsuno, K.** & Dasgupta, R. Subduction Cycling of C-O-H Volatiles Constrained by Near-Solidus Phase Relations of Water-undersaturated, Carbonated Pelite at 3 GPa *AGU Fall Meeting* (December 2010) [ORAL]
- **Tsuno, K.**, Frost, D.J. & Rubie, D.C. Core-mantle partitioning of oxygen on Earth and Mars. *AGU Fall Meeting*, (December 2010) [INVITED][ORAL]
- **Tsuno, K.**, & Dasgupta, R. Melting Phase Relation of Carbonated Pelites at Sub-arc Depth; Cycling of Sedimentary carbon in Subduction Zones. *MARGINS Successor Planning Workshop*, San Antonio, TX, USA (September 2010) [POSTER]
- **Tsuno, K.**, & Dasgupta, R. (2009) Melting phase relation of nominally anhydrous, carbonated pelite at sub-arc depths and cycling of sedimentary carbon in subduction zones. *AGU Fall Meeting* (December 2017) [POSTER]
- **Tsuno, K.**, Frost, D.J. & Rubie, D.C. The effects of Ni and S on partitioning of O between magnesiowüstite and metallic Fe liquid at high pressures. *33rd International Geological Congress*, Oslo, Norway (August 2008) [ORAL]
- **Tsuno, K.**, Frost, D.J. & Rubie, D.C. Effect of Ni and S on the partitioning of FeO between magnesiowüstite and liquid Fe at high pressures and temperatures. *The 3rd COE-21 International Symposium "Origin, Evolution and Dynamic of the Earth"*, Misasa, Japan (March 2007) [POSTER]
- **Tsuno, K.**, Frost, D.J. & Rubie, D.C. Partitioning of FeO between liquid Fe-Ni metal and magnesiowüstite up to 25 GPa at high pressures and temperatures. *AGU Fall Meeting* (December 2007) [POSTER]
- **Tsuno, K.**, Terasaki, H., Ohtani, E., Suzuki, A., Asahara, Y., Nishida, K., Sakamaki, T., Funakoshi, K., & Kikegawa, T. In situ observations of liquid immiscibility in the Fe-O-S melt at high pressure using an X-ray radiographic technique. *International Workshop on Synchrotron High-Pressure Mineral Physics and Materials Science*, Argonne, Illinois (December 2007) [ORAL]
- **Tsuno, K.**, Ohtani, E. & Terasaki, H. Immiscible two-liquid regions in the Fe-O-S melt up to 21 GPa and implications for the planetary cores. *19th general Meeting of the International Mineralogical Association*, Kobe, Japan (July 2006) [ORAL]
- **Tsuno, K.**, Ohtani, E. & Terasaki, H. Phase relations in the Fe-O-S system at high pressures. *AGU Fall Meeting* (December 2005) [POSTER]
- **Tsuno, K.**, Ohtani, E. & Terasaki, H. Melting relations in the Fe-FeO-FeS system at high pressures and implications for Earth's core. *"Advanced Science and Technology Center for the Dynamic Earth" International Symposium*, Sendai, Japan (May 2004) [POSTER]