Hee Choi

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Research Interests

Early Earth subduction • ML/AI application to geodynamic models • Plate tectonics onset • Subduction zone dynamics • Mantle convection modeling • Planetary evolution • Physics-informed ML • Grain-damage rheology • HPC geodynamics

Education

Ph.D. in Geosciences *Aug 2019 – Aug 2025*
Pennsylvania State University, University Park, PA

- **Dissertation Title:** The Origin and Evolution of Subduction in Early Earth: Insights from Geodynamic Models and Machine Learning-Based Detection
- **Advisor:** Bradford Foley

M.S. in Geophysics *Aug 2017 – Aug 2019*
University of Memphis, Memphis, TN

- **Thesis Title:** New Numerical Mid-ocean Ridge Models for Interactions Between Plate-driving and Resistant Force
- **Advisor:** Eunseo Choi

B.S. in Geophysics *Mar 2013 – Feb 2017*
Kangwon National University, Chuncheon, South Korea

Appointments

Postdoctoral Scholar *La Jolla, CA*
Institute of Geophysics and Planetary Physics *Nov 2026 – Present*
Scripps Institution of Oceanography, University of California San Diego

Postdoctoral Fellow *Atlanta, GA*
School of Earth and Atmospheric Sciences, Georgia Institute of Technology *June 2025 – Oct 2026*

- Integrated fluid–solid compaction modeling with geodynamic simulations to study fluid migration in subduction zones in early Earth
- Developed reproducible TerraFERMA/FEniCS workflows (CMake/MPI/PETSc) with Podman containers
- Assisted in writing NSF research proposals

Peer-Reviewed Publications

4. **Choi, H.** & Sim, S. (In Prep) Estimating Archean Oceanic Crust Composition and Its Role in Water Delivery in Subduction Settings
3. **Choi, H.** & Foley, B. J. (2026). Establishment of subduction at early Earth continent margins by migration: Implications for interpreting geochemical observations. *Earth and Planetary Science Letters*, 683, 119959. 10.1016/j.epsl.2026.119959
2. **Choi, H.** & Foley, B. J. (2026). Deep learning-based tracking of subduction zones in mantle convection models. *Journal of Geophysical Research: Solid Earth*, 131, e2025JB032355. 10.1029/2025JB032355 Code: 10.5281/zenodo.15778509

1. **Choi, H.** & Foley, B. J. (2024). A limited effect of continents on subduction initiation for convection with grain-damage. *Journal of Geophysical Research: Solid Earth*, 129, e2024JB029136. 10.1029/2024JB029136

Invited Talks

- *The Chicken and the Egg: Continents, Subduction, and the Shaping of Early Earth* at Earth and Planetary Sciences Seminar Series, University of California, Davis, Davis, CA, Nov. 18, 2026
- *A Two-Way Exchange: How Continents and Subduction Shaped Each Other on the Early Earth* at Geophysics Colloquium, Kangwon National University, Chuncheon, South Korea, Jun. 11, 2026
- *The Origin and Evolution of Subduction in Early Earth: Insights from Geodynamic Models and Machine Learning-Based Detection* at Solid Earth Seminar, Georgia Institute of Technology, Atlanta, GA, Aug. 29, 2025

Presentations

- *Estimating Archean Oceanic Crust Composition and Its Role in Water Delivery in Subduction Settings* by **H. Choi** and S. Sim, 2026 Ada Lovelace Workshop, Jun. 21-26, 2026, Seč, Czechia
- *Fluid migration in Archean subduction zones: Implications for TTG genesis* by **H. Choi**, S. Sim, and C. Wilson, AGU25, Dec. 15-19, 2025, New Orleans, LA
- *Deep learning-based tracking of subduction zones in mantle convection models* by **H. Choi** and B. Foley, AGU24, Dec. 9-13, 2024, Washington, D.C.
- *The role of continents in determining subduction zone locations on the early Earth: Insights from numerical models* by **H. Choi** and B. Foley, AGU Fall Meeting 2023, Dec. 11-15, 2023, San Francisco, CA
- *Dynamics of Subduction Initiation: Where Subduction Initiates with Respect to Continents* by **H. Choi** and B. Foley, AGU Fall Meeting 2022, Dec. 12-16, 2022, Chicago, IL
- *Dynamics of subduction initiation with respect to continents* by **H. Choi** and B. Foley, 2022 Ada Lovelace Workshop, Aug. 28 - Sep. 2, 2022, Hévíz, Hungary
- *A limited effect of continents on subduction initiation and lithospheric stress* by **H. Choi** and B. Foley, AGU Fall Meeting 2021, Dec. 13-17, 2021, New Orleans, LA
- *The role of continental lithosphere in subduction initiation* by **H. Choi** and B. Foley, AGU Fall Meeting 2020 DI020-0010, Dec. 1-17, 2020, Online
- *New numerical mid-ocean ridge models for interactions between plate-driving and resistant forces* by **H. Choi** and E. Choi, AGU Fall Meeting 2019 T13I-0281, Dec. 9-13, 2019, San Francisco, CA
- *Modeling interactions between plate-boundary forces and evolving resistance at mid-ocean ridges as the origin of non-uniform seafloor growth* by **H. Choi**, E. Choi, and R. Reece, AGU Fall Meeting 2018 T33G-3847, Dec. 10-14, 2018, Washington, D.C.

Outreach

- *Why is Earth so special? Inside our planet* at Sagamore Hills Elementary School, Dekalb County School District, Atlanta, GA, Mar. 9, 2026

Professional Services

Reviewer
Earth and Planetary Science Letters (EPSL)
NSF SPSE Program (ad hoc, 2026)

Session Chair

- *Delivery and Global Cycling of Volatiles in Rocky Planets*, AGU26, Dec. 7-11, 2026
- *Outer Space Rocks! Enhancing the Understanding of our Planetary Neighbors*, GSA 2025 Joint Northeastern/North-Central Section Meeting, Mar. 27-30, 2025

Teaching Experience

Instructor *SU 2023, SU 2024*
Summer course: Numerical Modeling and Data Visualization
Pennsylvania State University

- Taught a short summer course covering Python fundamentals, NumPy arrays, and Matplotlib plotting for geoscience applications.
- Guided students to complete a mini-project solving an easy geoscience problem in a reproducible notebook.

Graduate Teaching Assistant
GEOSC 203: Physical Processes in Geology *FA 2022, SP 2023, FA 2024*
Pennsylvania State University

- Led weekly labs applying physics/math to geologic problems; coached students through MATLAB workflows and quantitative reasoning.
- Ran field labs (gravity survey); supervised data collection, instrument setup, and field safety.
- Coordinated with the instructor to align labs with lectures; updated materials based on student performance and end-of-term feedback.

Graduate Teaching Assistant
The Earth System and Global Change *SP 2024*
Pennsylvania State University

- Held office hours and review sessions; clarified climate, ozone, deforestation, and biodiversity concepts with real-world datasets.
- Graded quizzes/labs with rubric-based feedback that improved figure quality, units/uncertainty reporting, and scientific reasoning.
- Supported inclusive teaching practices: structured participation and gentle scaffolding for non-STEM majors new to quantitative reasoning.

Technical Skills

Programming: Python, MATLAB, Fortran, C, C++
Machine learning: PyTorch, Tensorflow
Numerical modeling: TerraFERMA, FEniCS, PETSc, MPI, CMake
Thermodynamic modeling: Perple_X, MAGEMin
Computing: HPC clusters, Podman containers

Scholarships and Awards

Paul D. Krynine Awards *SP 2022, SP 2023*
Pennsylvania State University

Integrated Geoscience & Technology Education Program (CK1) Scholarship *FA 2014, SP 2015*
Kangwon National University

Semester Honor Scholarship *FA 2013, SP 2014, FA 2014, FA 2015*
Kangwon National University

Merit Scholarship *Fall 2013*
Kangwon National University