

Chase J. Shyu

Computational Geoscientist · Scientific Software Engineer (C++ / GPU / HPC)

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SUMMARY

Ph.D. computational geoscientist and core developer of **DynEarthSol**, an open-source C++ explicit finite-element geodynamics code. Nine years (2016–present) building, parallelizing, and validating large-scale simulation software with **OpenMP/OpenACC/CUDA**, benchmarked to **5 million elements** with **up to 4× GPU speedup** (H100 vs. 72-core Grace CPU). Runs an **AI-assisted engineering workflow** (custom Claude Code skills, review agents, regression gates). Delivered basin heat-flow histories for **hydrocarbon maturity assessment** to CPC Corporation, Taiwan’s national oil company. Lead author of DynEarthSol v2.0 (*Geosci. Model Dev.*, in review).

TECHNICAL SKILLS

Languages	C++ (primary), Python, Fortran 95, Bash
Parallel & HPC	OpenMP, OpenACC, CUDA; Structure-of-Arrays layouts; bit-reproducible parallel assembly; Docker
Numerics	Explicit Lagrangian FEM (FLAC), unstructured 2D/3D meshes, remeshing, two-phase flow, BVH search
Data & Tools	NumPy, pandas, matplotlib, Plotly; HDF5/VTK; ParaView; Git/GitHub code review, GitHub Actions CI; Conda
AI Engineering	Claude Code: custom skills & subagents, hooks, multi-agent code review, verification gates for AI-written code
Geoscience	Basin analysis & thermal maturity, rift tectonics, structural geology, low-T thermochronology (ZFT)

EXPERIENCE

Postdoctoral Fellow, Geodynamics

Jan 2025 – Present

Institute for Geophysics, University of Texas at Austin — Austin, TX

- Led **GPU acceleration** (OpenACC/CUDA) of DynEarthSol 3D: Structure-of-Arrays layout for coalesced access and a GPU BVH nearest-neighbor search (released standalone as **knn-bvh**, CUDA). Benchmarked to **5.0 M elements** on Grace, EPYC, A100, H100: **4.0× kernel / 3.3× end-to-end speedup** (H100 vs. 72-core Grace); **51.8× OpenMP scaling on 72 cores** (72% efficiency).
- Developing a **two-phase (melt/fluid) flow solver** in the explicit FLAC framework; applied to 3D magma migration during continental rifting (Afar) and to ice-shell convection and chaos terrain on Europa.
- Lead author of **DynEarthSol v2.0** (*Geosci. Model Dev.*, in review); presented new 3D features at AGU 2025 and CIG 2025.

Core Developer & Reviewer

2016 – Present

GeoFLAC open-source organization (DynEarthSol, MIT license) — remote

- **40 merged PRs** spanning physics, performance, and infrastructure: rewrote custom binary output as HDF5 (ParaView-readable), MMG remeshing with SPR stress recovery, deterministic restart, self-configuring build (auto-detected HDF5/OpenMP/Boost).
- Eliminated race conditions and non-deterministic round-off in OpenMP parallel assembly with a two-step node–element scheme, giving **bit-reproducible** results independent of thread count.
- Built an **AI-assisted development workflow** on Claude Code: 5 versioned skills (2,000+ lines of agent instructions, 15 scripts), 4 specialist review subagents fanned out over large diffs, and pre-commit bit-identity/restart-determinism gates so AI-generated C++ is verified before merge; a SessionEnd hook auto-archives sessions into a searchable knowledge base.

Research Collaborator (Principal Proposer)

Jan 2024 – Oct 2024

CPC Corporation & National Taiwan University — Taiwan

- Proposed and **secured industry funding** for “Sedimentary Basin Framework and Thermal History Evolution of the North West Shelf of Australia.”
- Built coupled thermo-mechanical rifting and deposition models and delivered basin **heat-flow histories** used by CPC for hydrocarbon maturity estimation; presented at AGU 2024.

Ph.D. Researcher, Earth System Science

2016 – 2024

Academia Sinica & National Central University — Taiwan

- Implemented **surface-process modules** (sediment-marker correction, depth-dependent diffusion) and optimized OpenMP/OpenACC performance in DynEarthSol; modeled rifted-basin formation and syn-rift stratigraphy (AGU 2017, GSA 2023).

EDUCATION

Ph.D. in Earth System Science, Academia Sinica & National Central University, Taiwan

2024

M.S. in Geosciences, National Taiwan University (zircon fission-track thermochronology; FLAC module development)

2014

B.S. in Geosciences, National Taiwan University

2011

SELECTED PUBLICATIONS & RECOGNITION

- **Shyu, C. J.**, Lee, S., Ding, X., Keum, J., Tan, E., Lavier, L. L., & Choi, E. (submitted 2026). DynEarthSol v2.0: An efficient explicit Lagrangian solver for geodynamics, surface processes, and earthquake-cycle dynamics. *Geosci. Model Dev.* [preprint]
- Tan, E., Lee, Y.-H., Chang, J.-B., Zheng, M.-J., & **Shyu, C. J.** (2024). Mountain building process of the Taiwan orogeny. *Science Advances*. [doi]
- **Shyu, C. J.**, Tan, E., Kirstein, L. A., Stuart, F. M., & Chen, Y.-G. (2023). Exhumation history of the middle Hsuehshan Range, Taiwan, from zircon thermochronological modeling. *Tectonophysics*, 860, 229907. [doi]
- 11 first-author presentations at AGU, EGU, GSA, and CIG (2013–2025).
- Awards: **Third Place (Taiwan)**, **NASA Space Apps Challenge 2018**; Outstanding Student Paper, Taiwan Geosciences Assembly 2019 and Geological/Geophysical Societies Joint Meeting 2018; **Outstanding Student Poster**, EGU 2013.