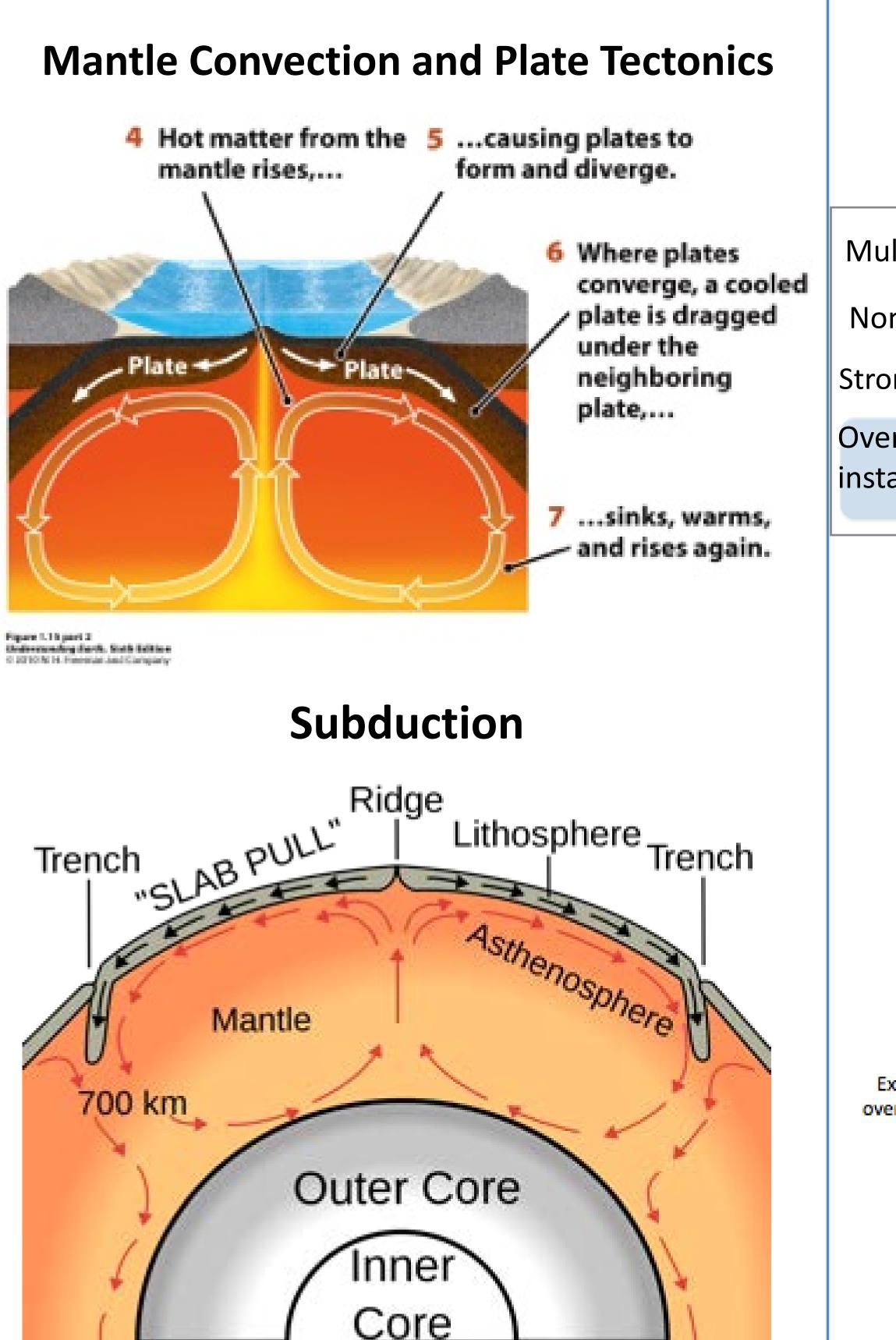
## Development and Implementation of Software Elements using State-of-the-Art Computational Methodology to Advance Modeling Heterogeneities and Mixing in Earth's Mantle Elbridge Gerry Puckett<sup>[1,3]</sup>, Magali I. Billen<sup>[2,3]</sup>, Ying He<sup>[1,3]</sup>, Scott I. Tarlow<sup>[2,3]</sup> UNIVERSITY OF CALIFORNIA [1] Department of Mathematics [2] Department of Earth and Planetary Sciences [3] Computational Infrastructure for Geodynamics

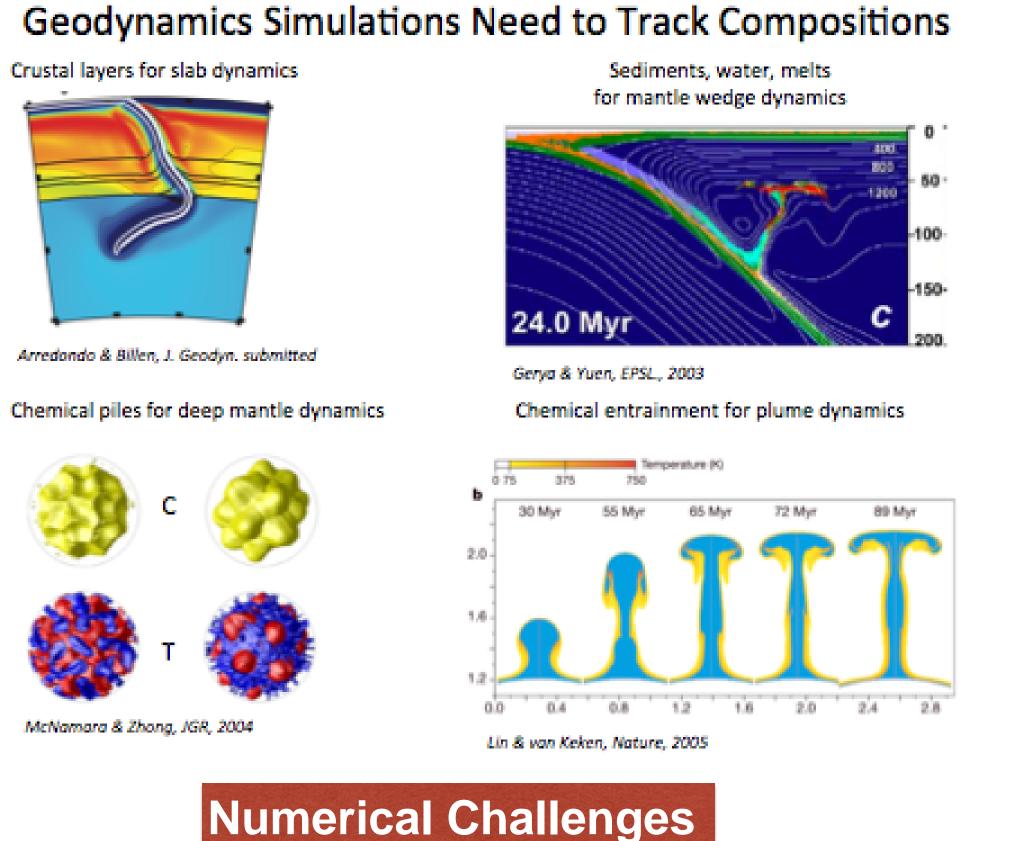


## The Geophysical Motivation

At the elevated pressures and temperatures of Earth's deep interior, mantle rock responds to stress by slow, creeping solid-state flow. The resulting convection in the Earth's mantle is the driving mechanism of plate tectonics, volcanism, earthquakes, mountain building, and other geologic activity.



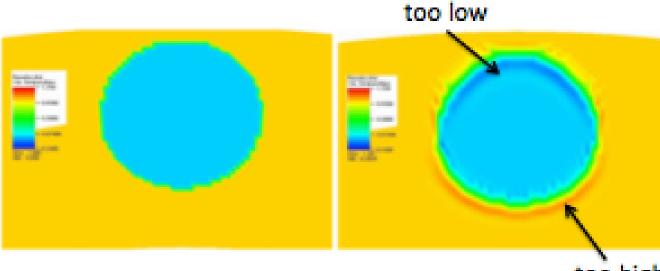
Subduction occurs when a cold tectonic plate plunges into the hot interior of the mantle.



- Multi-scale problem
- Nonlinear system
- Strong Discontinuities: composition field, viscosity and density
- Overshoot / undershoot: bound preserving, numerical instability

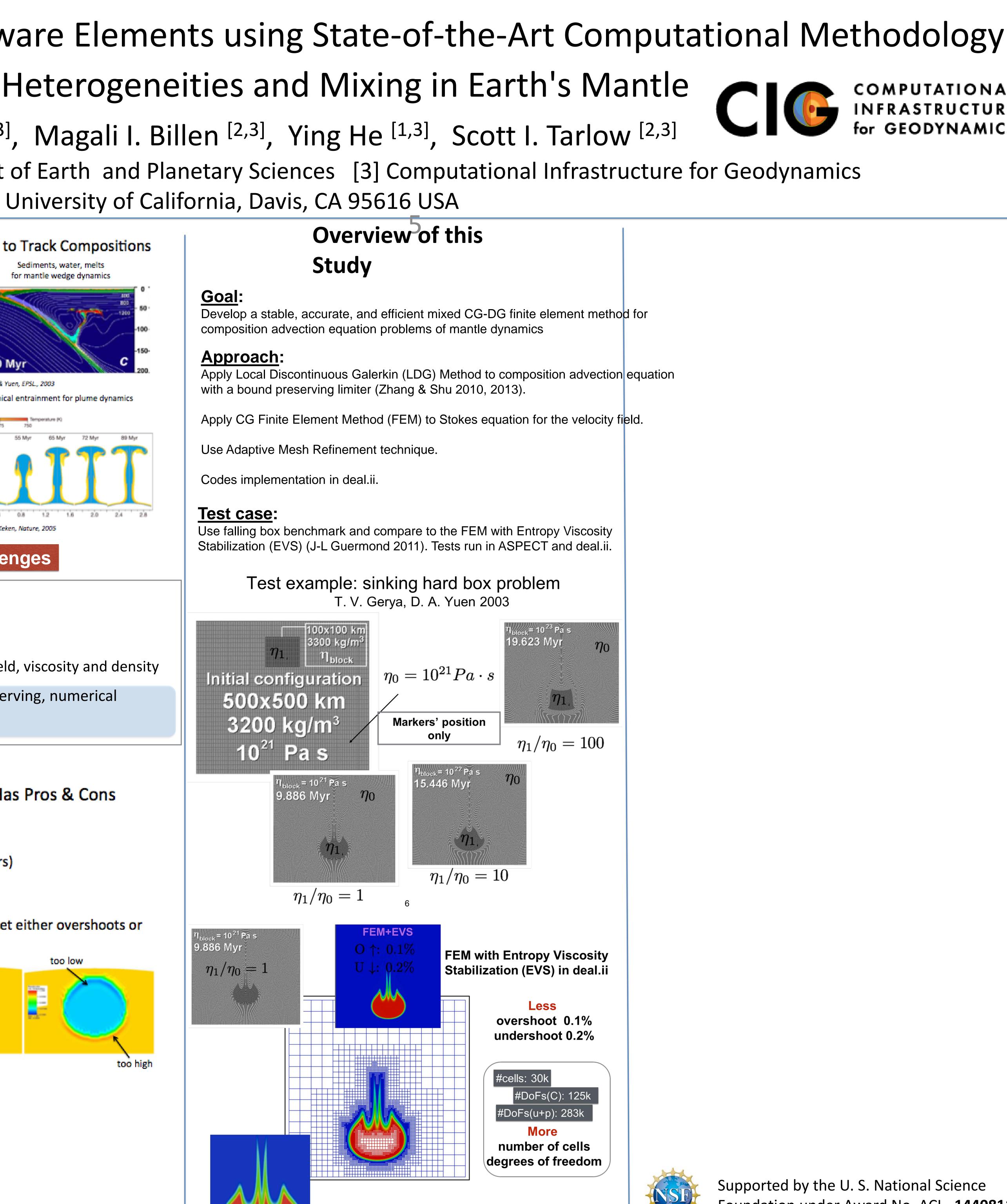
## Various Methods: Each Has Pros & Cons

- Tracers
  - Pros: separate from solver
  - Cons: expensive (lots of tracers)
- Field Method
  - Pros: cheaper
  - Cons: needs solver usually get either overshoots or excessive smoothing.



too high







Example of temperature overshoot for falling sphere from CitcomS

> **Control** overshot/undershoot by EVS but lose sharp boundary

COMPUTATIONAL INFRASTRUCTURE GEODYNAMICS

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